Fifth Annual Extra All-IBM Issue

BYTE

IBM SPECIAL EDITION

Battle of the Boards: Micro Channel vs. AT Bus
State of the Art in PC Graphics
Multitasking with DOS

Plus Unix • DOS 4.0 • OS/2
Communications • Memory Technology
Best of BIX • Expert Columnists

ebugger, Turbo Pascal 5.0

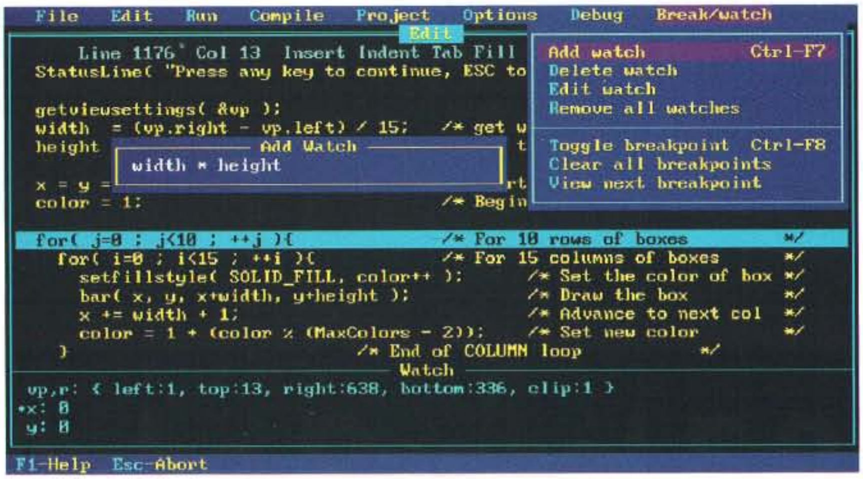
New! Turbo C® 2.0 with integrated source-level debugger

New Turbo C 2.0 is the *one* C compiler that does it all; nothing is half done or not done at all—instead, your every programming need is met. We wrote our best-selling word processor Sprint® with Turbo C; now you can write your own best seller with Turbo C 2.0.

At better than 16,000 lines a minute,* Turbo C 2.0 compiles your code 20-30% faster than its predecessor Turbo C 1.5 which was already faster than any other C compiler.

Make bugs bug off

Nice bugs are dead bugs, and Turbo C 2.0's integrated source-level debugger lets you find them and flatten them in a flash. You can set multiple breakpoints, watch variables and evaluate expressions—all from inside your integrated C environment.



```
    Line 1176  Col 13  Insert Indent Tab Fill
StatusLine( "Press any key to continue, ESC to

getviewsettings( &vp );
width  = (vp.right - vp.left) / 15;   /* get w
height                                       t
            width * height
x = y =                                      rt
color = 1;                            /* Begin

for( j=0 ; j<10 ; ++j ){              /* For 10 rows of boxes      */
  for( i=0 ; i<15 ; ++i ){            /* For 15 columns of boxes   */
    setfillstyle( SOLID_FILL, color++ );    /* Set the color of box */
    bar( x, y, x+width, y+height );         /* Draw the box        */
    x += width + 1;                         /* Advance to next col */
    color = 1 + (color % (MaxColors - 2));  /* Set new color       */
  }                             /* End of COLUMN loop           */
vp,r: { left:1, top:13, right:638, bottom:336, clip:1 }
•x: 0
 y: 0
```

Debugging in the Turbo environment: shown here an expression is being added to the Watch window in Turbo C. The Execution Bar highlights the next line the debugger will execute.

TURBO C 2.0

HEAPSORT BENCHMARK	TURBO C 2.0	Microsoft® C 5.1
.OBJ size (bytes)	843	945
.EXE size (bytes)	6896	7731
Execution time (seconds)	8.1	12.2
FEATURE COMPARISON		
Integrated debugger	Yes	No*
Inline assembly	Yes	No
Auto dependency checking	Yes	No
EMS support for edit buffer	Yes	No
Device-independent graphics	Yes	No
Number of memory models	6	5
Price	$149.95	$450.00

Heapsort compiled with full optimization. Benchmark run on an IBM PS/2 Model 60.
*Integrated debugger included with Quick C.

Minimum system requirements: For the IBM PS/2™ and the IBM® family of personal computers and all 100% compatibles. PC-DOS (MS-DOS) 2.0 or later. Turbo Debugger minumum 384K. Turbo Assembler minimum 256K. Turbo C and Turbo Pascal minimum 448K (256K comment line version).

*Customer satisfaction is our main concern; if within 60 days of purchase this product does not perform in accordance with our claims, call our customer service department, and we will arrange a refund.

Prices and specifications subject to change without notice.

All Borland products are trademarks or registered trademarks of Borland International, Inc.
Other brand and product names are trademarks or registered trademarks of their respective holders.
Copyright ©1988 Borland International, Inc. BI 1290

Turbo C and Turbo Pascal owners, upgrade now! CALL (800) 543-7543

If you're a registered Turbo C and/or Turbo Pascal owner, you can upgrade and get the latest version of your favorite language, plus both Turbo Assembler and Turbo Debugger, all at special upgrade prices. Whether you order by phone or mail, be sure to include your old Turbo Pascal and/or Turbo C serial numbers and the code PL02.

Mail coupon to: Borland, Attn: Dept. PL02, 1800 Green Hills Road,
P.O. Box 660005, Scotts Valley, CA 95066-0005.

UPGRADE OFFERS For registered Turbo Pascal® and Turbo C® owners! (Unregistered owners, see below*)

Name

Shipping address

City State Zip

( )
Telephone

To qualify for the upgrade price you must give the serial number of the equivalent product you are upgrading.

Turbo Pascal Serial Number

Turbo C Serial Number

Upgrades for registered Turbo C and Turbo Pascal owners	Suggested Retail	Upgrade Price
Please check box(es)		
1 ☐ Turbo C 2.0 Professional (Includes both Turbo Assembler and Turbo Debugger)	250.00	99.95
2 ☐ Turbo Pascal 5.0 Professional (Includes both Turbo Assembler and Turbo Debugger)	250.00	99.95
3 ☐ Turbo Pascal with 5.0 upgrade manual and disks	N/A	49.95
4 ☐ Turbo C with 2.0 upgrade manual and disks	N/A	49.95

Please specify diskette size: Either ☐ 5¼" OR ☐ 3½"

Total product amount	$ ________
CA and MA residents add sales tax	$ ________
In US please add $5 shipping/handling for each product	$ ________
In Canada please add $10 shipping/handling for each product	$ ________
Total amount enclosed	$ ________

Payment: ☐ VISA ☐ MC ☐ Check ☐ Bank Draft Credit card expiration date: ____/____

Card # | | | | | | | | | | | | | | | | | | |

Name as it appears on card ________________

*If you have not registered your Turbo Pascal or Turbo C, you may qualify for the special price by including your completed registration card with this coupon and payment. Offer good September 1 through November 30, 1988. Coupon must be postmarked before December 15, 1988. Offer good in U.S. and Canada only. This offer limited to one upgrade per valid product serial number. Not good with any other offer from Borland. CODs and purchase orders will not be accepted by Borland.

Circle 32 on Reader Service Card (DEALERS: 33)

Turbo Assembler, Turbo D

What started modestly enough in November of 1983 with the launch of Borland's first program, Turbo Pascal® 1.0, became a revolution and it's been going like a rocket ever since.

We've changed the way you program.

We invented integrated environments with Turbo Pascal and we brought them to all our languages. Borland continues to bring you the best programming tools in the world.

New! Turbo Assembler & Turbo Debugger

Two state-of-the-art development tools in one package for only $149.95.

New Turbo Debugger® debugs all sizes

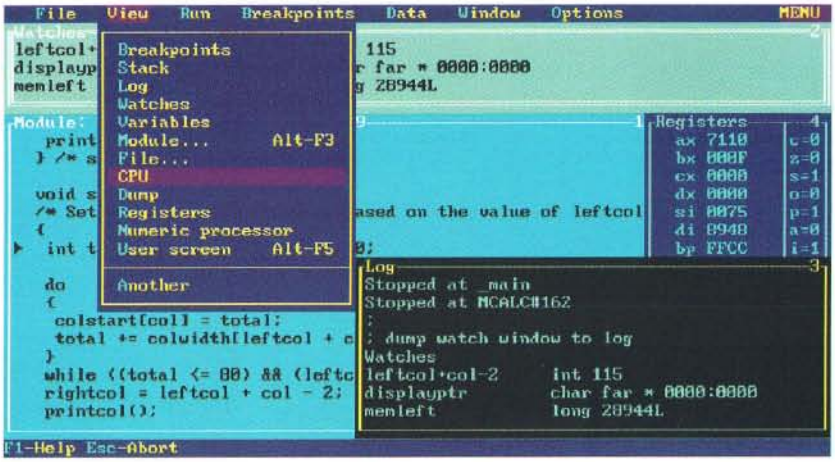
With EMS support, remote debugging, and 386 virtual machine debugging, there's no limit to the size of program you can debug. In fact with 386 virtual machine mode, debugging takes ***zero,*** bytes of conventional memory!

See what's happening

Overlapping windows give you multiple views of the program you're debugging: source code, variables, CPU registers, call stack, watches, breakpoints, memory dump, and more. And a new "session-logging" feature tracks and records your every move.

You're in control

Our breakpoints give you more control than anyone else's. Ordinary debuggers only get you to a stop, then they stop. When our breakpoints are triggered you can simply stop, or you can print expressions, run code, send messages to the session log, or even evaluate an expression with user-defined function calls. And ***all*** our breakpoints are conditional.



```
leftcol+          115
displayp        r far * 0000:0000
memleft         g 28944L
```

```
  print
  } /* s

  void s
  /* Set                ased on the value of leftcol
  {
▶  int t                0;

   do
   {
    colstart[col] = total;
    total += colwidth[leftcol + c
   }
   while ((total <= 80) && (leftc
   rightcol = leftcol + col - 2;
   printcol();
```

```
ax 7110   c=0
bx 000F   z=0
cx 0000   s=1
dx 0000   o=0
si 0075   p=1
di 0948   a=0
bp FFCC   i=1
```

```
Stopped at _main
Stopped at MCALC#162
;
; dump watch window to log
Watches
leftcol+col-2        int 115
displayptr           char far * 0000:0000
memleft              long 28944L
```

Shown here are views of source code, CPU registers, watch expressions, and a session log.

Unique Data Debugging

Plain Vanilla debuggers can only give you ***code*** debugging. Our new Turbo Debugger give you ***data*** debugging too. You can browse through your data from the simplest byte to the hairiest data structure, inspect arrays, and walk through linked lists. All by point and shoot.

Feature highlights

Breakpoints

- Actions: stop, run code, log expression
- Break on condition, memory changed
- Software ICE capabilites
- 386 debug register support
- Support for hardware debuggers

Debug any program

- Turbo Pascal, Turbo C, Turbo Assembler
- EMS support
- 386 virtual machine and remote machine debugging
- Supports CodeView® and .MAP-compatible programs

Data Debugger

- Follow pointers through linked lists
- Browse through arrays and data structures
- Change data values

New Turbo Assembler® lets you write the tightest, fastest code

Turbo Assembler is faster than other assemblers, and you can use it on your existing code. It's fully MASM compatible, 4.0, 5.0, and 5.1; even MASM can't say that. Turbo Assembler takes you beyond MASM, with significant new Assembly language extensions, more complete error checking, and full 386 support.

Turbo Assembler is designed for easy interfacing with high-level languages like Turbo Pascal and Turbo C. We use Turbo Assembler on Quattro,® our best-selling spreadsheet program; now you can write your own best-seller with Turbo Assembler!

Feature highlights

- Faster than other assemblers
- MASM compatible (4.0, 5.0, and 5.1)
- Significant new assembly language extensions
- Easy interfacing with high-level languages including Turbo C and Turbo Pascal
- Full 386 support

TURBO DEBUGGER

FEATURE COMPARISON	TURBO DEBUGGER	CodeView®
Multiple overlapping views	Yes	No
386 virtual-86 mode debugging	Yes	No
Remote debugging	Yes	No
Data debugging	Yes	Partial
Generalized breakpoints	Yes	No
Session logging	Yes	No
Conventional memory used—80386	Zero K	230K
Conventional memory used—remote	15K	N/A

Turbo Debugger version 1.0, Microsoft CodeView version 2.2.

TURBO ASSEMBLER

BGIDEMO BENCHMARK	TURBO ASSEMBLER	Microsoft® Assembler
Assembly time (seconds)	9.34	27.46
Link time (seconds)	4.15	10.51
FEATURE COMPARISON		
MASM compatible (4.0, 5.0, 5.1)	Yes	No
Thorough type checking	Yes	No
Nested structures and unions	Yes	No
Multimodule cross reference	Yes	No
Assemble multiple files	Yes	No

Run on IBM PS/2 model 60 using Turbo Assembler version 1.0, Turbo Linker version 2.0, Microsoft Macro Assembler version 5.10, Microsoft Overlay Linker version 3.64.

The Revolution continues with our new . . .

TURBO C
TURBO C
TURBO C PROFESSIONAL
TURBO C PROFESSIONAL
TURBO ASSEMBLER/ DEBUGGER
TURBO ASSEMBLER/ DEBUGGER
TURBO PASCAL PROFESSIONAL
TURBO PASCAL PROFESSIONAL
TURBO PASCAL
TURBO PASCAL
BORLAND
2.0
1.0
5.0

and Turbo C 2.0!

Turbo C 2.0 has the best of everything

- Includes the compiler, editor, and debugger, all rolled into one
- Integrated source-level debugger lets you step code, watch variables, and set breakpoints
- Develop and debug production-quality code in all six memory models
- Inline assembler support
- Support for Turbo Assembler and Turbo Debugger
- Make facility with automatic dependency checking
- Over 430 library functions, including a complete graphics library
- Only $149.95

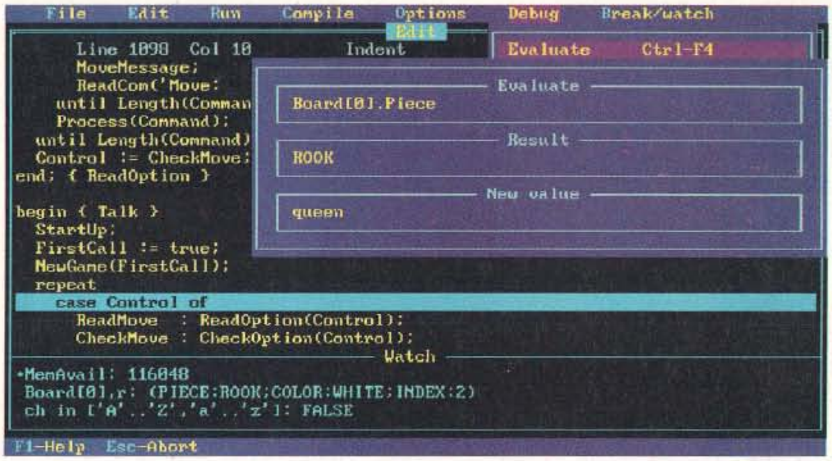
New Turbo C Professional

Turbo C 2.0 plus *both* Turbo Assembler & Turbo Debugger: all three programs rolled into one—the ***one*** C package that has everything. A complete set of tools that caters to every level of programming expertise. Turbo C Professional: $250. Includes coupon for free T-shirt (while supplies last).

New! Turbo Pascal® 5.0 with integrated source-level debugger

Turbo Pascal, the worldwide favorite with over a million copies in use, just got even smarter. The best got better. Meet Version 5.0. In a word, it's revolutionary.

Not only do you go code-racing at more than 34,000 lines a minute,* you also now go into a sophisticated debugging environment—right at source level. It's completely integrated and bullet-fast.



```
    Line 1898  Col 18
    MoveMessage;
    ReadCom('Move:
  until Length(Comman
  Process(Command);
 until Length(Command)
 Control := CheckMove;
end; { ReadOption }

begin { Talk }
 StartUp;
 FirstCall := true;
 NewGame(FirstCall);
 repeat
   case Control of
    ReadMove  : ReadOption(Control);
    CheckMove : CheckOption(Control);
```

```
Board[0].Piece
ROOK
queen
```

```
•MemAvail: 116048
 Board[0],r: (PIECE:ROOK;COLOR:WHITE;INDEX:2)
 ch in ['A'..'Z','a'..'z']: FALSE
```

Shown here is the Evaluate/Modify window of Turbo Pascal: look at expressions, examine structured data types, change variables on the fly.

Turbo Pascal's new integrated debugger takes you inside your code for fast fixes. You step, trace, set multiple breakpoints. You modify variables as you debug and watch full expressions at runtime.

Separate Compilation

Break your code into units. Your separately compiled units can be shared by multiple programs and linked in a flash with Turbo Pascal's built-in Make utility and smart linker. We give you a powerful library of standard units including the spectacular Borland Graphic Interface and our state-of-the-art overlay manager.

TURBO PASCAL 5.0	TURBO PASCAL 5.0	Turbo Pascal 4.0
SIEVE BENCHMARK		
.EXE size (bytes)	1440	1504
Execution time (seconds)	6.15	7.25
FEATURE COMPARISON		
Integrated debugger	Yes	No
Overlays, including EMS support	Yes	No
8087 floating-point emulation	Yes	No
Turbo Debugger support	Yes	No
Procedural types, variables, parameters	Yes	No
Smart linking of code and data	Yes	No
Constant expressions	Yes	No
EMS support for editor	Yes	No

Benchmark (25 iterations) run on an IBM PS/2 Model 60.

Feature highlights

- Includes the compiler, editor, and debugger, all rolled into one
- Integrated source-level debugger lets you step code, watch variables, and set breakpoints
- Overlays, including EMS support
- 8087 floating-point emulation
- Support for Turbo Assembler and Turbo Debugger
- Procedural types, variables, and parameters
- Smaller, tighter programs: Smart Linker strips both unused code and data
- Constant expressions
- EMS support for editor
- Only $149.95

Debugging: The inside story

Turbo Pascal's new integrated source-level debugger takes you inside your code to fix errors fast. Don't worry about errors, everyone makes them; but with the right debugger, this one, it's a fast fix.

Turbo Pascal Professional®

Turbo Pascal 5.0 plus *both* Turbo Assembler & Turbo Debugger: all three programs rolled into one—the ***one*** Pascal package that has everything. A complete set of tools that caters to every level of programming expertise. Turbo Pascal Professional: $250. Includes coupon for free T-shirt (while supplies last).

60-day money-back guarantee†

BORLAND

For the dealer nearest you
Call (800) 543-7543

Circle 34 on Reader Service Card (DEALERS: 35)

© 1988 Hayes Microcomputer Products, Inc.

A MODEM THAT IS TWICE AS GOOD AS IT LOOKS.

It says 9,600 bps. But for this modem, transmitting data at 9,600 bps over dial-up lines isn't the half of it.

Its built-in data compression can boost throughput to 19,200 bps. While error-control prevents loss of data.

With no effort on your part — no selecting protocols, no compressing files.

A V-series Smartmodem 9600™ can even take the place of two modems. Because it communicates in either synchronous or asynchronous mode.

All of which makes our 9600 at least twice as good as it seems. Or, looking at it the other way, more than double your money's worth.

For your nearest Hayes dealer, call **800-635-1225**. Hayes Microcomputer Products, Inc., P.O. Box 105203, Atlanta, GA 30348. **Hayes®**

Circle 105 on Reader Service Card

VOLUME 13, NUMBER 11, 1988
BYTE

IBM SPECIAL EDITION

BYTE (ISSN 0360-5280) is published monthly with an additional issue in October by McGraw-Hill, Inc. Founder: James H. McGraw (1860–1948). Executive, editorial, circulation, and advertising offices: One Phoenix Mill Lane, Peterborough, NH 03458, phone (603) 924-9281. Office hours: Monday through Thursday 8:30 AM–4:30 PM, Friday 8:30 AM–1:00 PM, Eastern Time. Address subscriptions to BYTE Subscriptions, P.O. Box 7643, Teaneck, NJ 07666-9866. **Postmaster:** Send address changes, USPS Form 3579, undeliverable copies, and fulfillment questions to BYTE Subscriptions, P.O. Box 7643, Teaneck, NJ 07666-9866. Second-class postage paid at Peterborough, NH 03458 and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Subscriptions are $22.95 for one year, $39.95 for two years, and $55.95 for three years in the U.S. and its possessions. In Canada and Mexico, $25.95 for one year, $45.95 for two years, $64.95 for three years. $75 for one-year air delivery to Europe. Y28,800 for one-year air delivery to Japan, Y14,400 for one-year surface delivery to Japan, $40 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is $3.50 in the U.S. and its possessions, $3.95 in Canada, $4.50 in Europe, and $5 elsewhere. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue. Printed in the United States of America.

Address editorial correspondence to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Unacceptable manuscripts will be returned if accompanied by sufficient postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE.

Copyright © 1988 by McGraw-Hill, Inc. All rights reserved. Trademark registered in the United States Patent and Trademark Office. Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any article herein for the flat fee of $1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 29 Congress St., Salem, MA 01970. Specify ISSN 0360-5280/83, $1.50. Copying done for other than personal or internal reference use without the permission of McGraw-Hill, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to the publisher.

BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London WCIR 4EJ, England.

Subscription questions or problems should be addessed to: BYTE Subscriber Service, P.O. Box 7643, Teaneck, NJ 07666-9866.

COVER ILLUSTRATION: ROBERT TINNEY

TRENDS

10 Editorial: Two Roads
by Kenneth M. Sheldon

14 Probing the State of the Art
by Jerry Pournelle

33 Mapping the Software World
by Ezra Shapiro

45 Beefed-up Bulletin Boards
by Brock N. Meeks

53 Migrating: Up or Down?
by Wayne Rash Jr.

59 OS/2 Dreams
by Mark Minasi

67 To Mac and Back
by Don Crabb

75 DOS 4.0
by Rich Malloy

81 Memory Board Roundup
by Rich Malloy

TECHNOLOGY

90 The Micro Channel versus the AT Bus
by Kerry Newcom

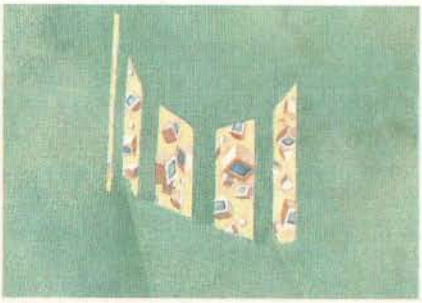
101 Keeping Up with the CPU
by Mark L. Van Name

109 Whither IBM and Unix?
by Jason Levitt

117 DOS Meets Unix
by Dale Dougherty and Tim O'Reilly

129 Graphics: The Big Picture
by Bill Nicholls

142 Life After DOS
by Namir Clement Shammas



TECHNIQUES

153 OS/2 Communications
by Jim Gilliland

169 Keep Your PC Healthy
by Gene B. Williams

177 Writing OS/2 Graphics Programs
by Mitchell M. McLain and Timothy E. Stevenson

187 VGA Video Modes
by Richard Wilton

201 Exploring OS/2 with a Lisp Interpreter
by Andrew Schulman

PLUS:

209 Best of BIX

245 Editorial Index by Company

The Dell System 220. Once again the critics stole the words right out of our mouth.

"The Dell System 220 runs most PC Labs system benchmark tests at speeds that would make you think you're running a 386."
—PC MAGAZINE

"the Dell machine is renewed evidence that the price of 286-based desktop equipment continues to drop rapidly, making such machines very attractive for daily work under MS-DOS even as they hold out the promise of running OS/2 in the future."
—WILL FASTIE, PC WEEK

"...includes a year's on-site support...in the price of the computer. This is the sweetest support deal offered by any computer vendor in the industry."
—ERIC KNORR, PC WORLD

"The hot item from a technical point of view is the System 220. This machine runs a 286 processor at 20 MHz, which is its major claim to fame."
—WILL FASTIE, PC WEEK

"the System 220 has more going for it than just speed."
—PC WORLD

The reviews are beginning to pour in.

And they read like a wish list for every power user looking to exceed the ordinary limitations of a 286 computer.

The computer everyone is praising in such glowing terms is the Dell System 220.

The first 286 computer with a clock speed of 20 MHz.

It's totally MS-DOS® and MS® OS/2 compatible. Yet it sells for much less than you may pay for a 386 computer.

Because you buy it direct from us.

Eliminating the mark-ups and margins of computer stores.

We design and build every Dell computer right here in Austin, Texas.

We put each and every one through a comprehensive burn-in and a battery of diagnostic tests before we ship it.

And after we ship, we give you the best technical support you'll find anywhere in the computer industry.

Our technicians are on the phone from 7AM to 7PM every business day.

Almost any question you may have about a Dell system can be answered over the phone.

And, in the rare case, that your question can't be answered by an on-line technician, we'll send a Honeywell Bull technician by the next business day.

A full year of on-site Honeywell Bull service is included within the purchase price of your Dell system.

Your Dell computer also comes with a thirty-day money back guarantee.

And we back every one of our computers with a one year limited warranty on any defective parts or workmanship.

For more information about Dell computers, read the reviews in the trade press, turn the page, review our product offerings, and call us at (800) 426-5150.

You'll like what we have to say.

DELL
COMPUTER
CORPORATION

TO ORDER, CALL
800·426·5150
IN THE U.S. AND CANADA

The Dell Computer Store.

Welcome to our store.

We believe you'll find this an extremely pleasant shopping experience.

Our sales staff is on hand to serve you from 7AM to 7PM (CST) from Monday thru Friday.

Just call (800) 426-5150 and we'll give you the technical assistance and information you need to make sure you're buying the system that's right for your needs.

Then you have the option of either a direct purchase or your company can take advantage of our Leasing Plan.

Once you've made your choice, our Total Satisfaction Guarantee gives you thirty days from the day you receive your system, to decide if you are absolutely, totally satisfied with the product.

If you're not, simply return the system and you'll receive a full refund. No questions asked.

Your Dell computer is supported by a team of technical experts that can be reached every business day, from 7AM to 7PM (CST), simply by calling (800) 624-9896.

In most cases, any question you may have about your Dell system can be answered by one of our technicians on the telephone.

Our technicians are also supported by Honeywell Bull service engineers who can be sent to your office by the next business day, should on-site service be required.

This optional service contract is available in over 95% of the United States, with over 1,000 engineers in 198 service locations.

We also offer a One Year Limited Warranty,** which warrants each system we manufacture to be free of defects in materials and workmanship for one full year.

Feel free to call or write for the complete terms of our Honeywell Bull Service Contract, Guarantee and Warranty. Dell Computer Corporation, 9505 Arboretum Blvd., Austin, Texas 78759-7299.

THE NEW 20 MHz 386† SYSTEM

310.

The top of the line. It's our highest performance computer available, faster than the IBM† PS/2† Model 80 and the Compaq† 386/20. It runs at 20 MHz with the latest 32-bit architecture. Since it also has Intel's Advanced 82385 Cache Memory Controller, and high performance disk drives, the System 310 is ideal for intensive database management, complex spreadsheet development, CAD/CAM, desktop publishing or performance as a network file server.

Standard Features:

- Intel† 80386 microprocessor running at 20 MHz.
- 1 MB of RAM (640K usable) expandable to 16 MB without using an expansion slot.
- Advanced Intel 82385 Memory Controller with 32 KB of high speed static RAM.
- Socket for 20 MHz 80387 or Weitek coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard disk drive controller.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 expansion slots (6 available).

Performance Enhancements (Systems 310 and 220):

- 384 KB of dedicated RAM is used by portions of the system software for increased performance.

***Lease for as low as $148/Month.*

System 310	With Monitor & Adapter	
Hard Disk Drives	VGA Mono	VGA Color Plus
40 MB – 28 ms	$4,099	$4,399
90 MB – 18 ms ESDI	$4,899	$5,199
150 MB – 18 ms ESDI	$5,399	$5,699
322 MB – 18 ms ESDI	$7,399	$7,699

THE NEW 20 MHz 286 SYSTEM

220.

As fast as most 386 computers, at less than half the price—more power for the money than any other system. An 80286 system that runs at 20 MHz, with less than one wait state. Completely compatible for both MS-DOS® and MS® OS/2 applications (it runs faster than IBM PS/2 Model 80), and with a remarkably small footprint, the System 220 is the ideal executive workstation.

Standard Features:

- 80286 microprocessor running at 20 MHz.
- 1 MB of RAM (640K usable) expandable to 16 MB (8 MB* on system board).
- Page mode interleaved memory.
- Integrated diskette and VGA video controller on system board.
- One 3.5" 1.44 MB diskette drive.
- Integrated high performance hard disk interface on system board.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- LIM 4.0 support for memory over 1 MB.
- Three full-sized AT† compatible expansion slots available.
- Socket for 80287 coprocessor.

Options:

- External 5.25" 1.2 MB diskette drive.
- 3.5" 1.44 MB diskette drive.
- Intel 80287 coprocessor.
- 1 MB RAM upgrade kit.

***Lease for as low as $85/Month.*

System 220	With Monitor		
	VGA Mono	VGA Color	VGA Color Plus
One Diskette Drive	$2,299	$2,499	$2,599
40 MB – 29 ms Hard Disk	$2,999	$3,199	$3,299
100 MB – 29 ms Hard Disk	$3,799	$3,999	$4,099

THE 12.5 MHz SYSTEM 200.

A great value in a full-featured AT compatible. An 80286 computer running at 12.5 MHz, this computer is completely MS-DOS and MS OS/2 compatible. The System 200 offers high speed drive options, industry standard compatible BIOS and on-site service. As Executive Computing said of this computer's predecessor, "If faster processing speed and low cost are two key issues affecting your purchase decision, this machine might be the ideal choice for your office."

Standard Features:

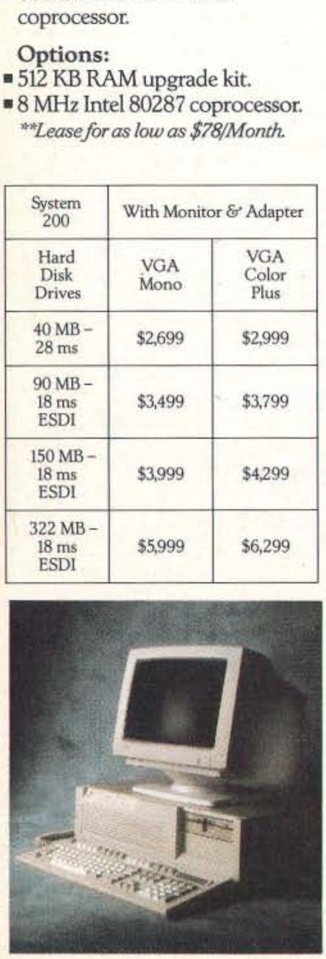
- Intel 80286 microprocessor running at 12.5 MHz.
- 640 KB of RAM expandable to 16 MB (4.6 MB* on system board).
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard disk drive controller.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200 watt power supply.
- Real-time clock.
- 6 expansion slots. (4 available with hard disk drive controller and video adaptor installed).
- Socket for 8 MHz 80287 coprocessor.

Options:

- 512 KB RAM upgrade kit.
- 8 MHz Intel 80287 coprocessor.

***Lease for as low as $78/Month.*

System 200	With Monitor & Adapter	
Hard Disk Drives	VGA Mono	VGA Color Plus
40 MB – 28 ms	$2,699	$2,999
90 MB – 18 ms ESDI	$3,499	$3,799
150 MB – 18 ms ESDI	$3,999	$4,299
322 MB – 18 ms ESDI	$5,999	$6,299



A Full Line Of Computers With A Full Line Of Configurations.

At Dell, we understand that different users have different needs. So we tailor each system to the user's individual requirements.

We offer monitors, graphics boards, tape backups, dot matrix and laser printers, hard disk and diskette drives, expanded memory boards, serial mice and more.

We also offer third party software applications for virtually every business application including: accounting, communications, desktop publishing, graphics, word processing, integrated applications and user training.

So when your Dell System arrives, you can do productive work the minute you unpack the box.

We can build you the system you've been looking for.

COMMON TO THE SYSTEM 310, SYSTEM 220 AND SYSTEM 200:

The Dell System Analyzer. Guaranteed hardware and software compatibility. Security lock with locking chassis. 12 month on-site service contract (Available on complete systems).

PRINTERS/SOFTWARE. *We offer a full line of printers and popular software. All printers come with our 30-day money-back guarantee.*

LASER PRINTERS.

LASER SYSTEM 150; $5,995.
15 pages per minute, text and full-page graphics.
Dual 250 sheet-input trays.

LASER SYSTEM 80; $3,295.
8 pages per minute, text and full-page graphics.

LASER SYSTEM 60; $2,195.
6 pages per minute, text and full-page graphics.

DOT MATRIX PRINTERS.

PRINTER SYSTEM 800; $699.95.
Highest resolution text and graphics from a 24-wire dot matrix printer.
Draft quality at 200 cps.
Correspondence quality at 132 cps.
Letter quality at 66 cps.
Standard parallel and serial interfaces.
Wide carriage.

PRINTER SYSTEM 600; $499.95.
9-wire dot matrix.
Draft quality at 240 cps.
Near-letter quality at 60 cps.
Standard parallel interface.
Wide carriage.

PRINTER SYSTEM 300; $199.95.
9-wire dot matrix.
Draft quality at 144 cps.
Near-letter quality at 36 cps.
Four standard fonts.
Paper parking.
Standard parallel interface.

OPERATING SYSTEMS.

Dell Enhanced MS-DOS 3.3 with disk cache and other utilities; $119.95.
Dell Enhanced MS OS/2 Standard Edition 1.0 $324.95.

DELL
COMPUTER
CORPORATION

TO ORDER, CALL
800·426·5150
IN THE U.S. AND CANADA

All prices and specifications are subject to change without notice. Please inquire for current details. Dell cannot be responsible for errors in typography or photography. In Canada, leasing is not currently available and configurations and prices may vary. Microsoft,® MS® and MS-DOS® are owned by Microsoft Corp. †Signifies registered or unregistered trademarks owned by entities other than Dell Computer Corporation. *Available January 1, 1989. **Payments based on a 36-month open-end lease. Please inquire for further details.

© 1988 DELL COMPUTER CORPORATION.

AD CODE NO. 11EK8

Circle 72 on Reader Service Card

BYTE

EDITOR IN CHIEF
Frederic S. Langa

OPERATIONS
Glenn Hartwig *Associate Managing Editor*

REVIEWS (Hardware, Software, Product Focus)
Cathryn Baskin *Associate Managing Editor*, Dennis Allen *Senior Technical Editor, Software*, Stephen Apiki *Testing Editor, BYTE Lab*, Stanford Diehl *Testing Editor, BYTE Lab*

NEWS AND TECHNOLOGY (Microbytes, What's New, Short Takes)
Rich Malloy *Associate Managing Editor*, D. Barker *Senior Editor, News and Technology*, Anne Fischer Lent *Senior Editor, New Products*
Peterborough: Roger Adams *Associate News Editor*, David Andrews *Associate News Editor*, Martha Hicks *Associate News Editor*
West Coast: Gene Smarte *Bureau Chief*, Costa Mesa, Nicholas Baran *Technical Editor*, San Francisco, Frank Hayes, *Associate News Editor*, Marlene Nesary *Associate News Editor*, Jeffrey Bertolucci *Editorial Assistant*, San Francisco

SENIOR TECHNICAL EDITORS
Ken Sheldon *Features*, Jane Morrill Tazelaar *In Depth*, Richard Grehan *At Large*, Tom Thompson *At Large*

TECHNICAL EDITORS
Janet J. Barron, Janet Fiderio, Jon Udell, Stanley Wszola

ASSOCIATE TECHNICAL EDITOR
Robert Mitchell

CONSULTING EDITORS
Steve Ciarcia, Jerry Pournelle, Ezra Shapiro, Don Crabb, Brock N. Meeks, Mark Minasi, Wayne Rash Jr.

CONTRIBUTING EDITORS
Jonathan Amsterdam *Programming Projects*, Mark Dahmke *Video, Operating Systems*, Mark Haas *At Large*, Rik Jadrnicek *CAD, Graphics, Spreadsheets*, Robert T. Kurosaka *Mathematical Recreations*, Alastair J. W. Mayer *Software*, Stan Miastkowski *New Technology*, Alan R. Miller *Languages and Engineering*, Dick Pountain *Algorithms*, Roger Powell *Computers and Music*, Phillip Robinson *Semiconductors*, Jon Shiell *High-Performance Systems*, George A. Stewart *Book Reviews*, Ernest Tello *Artificial Intelligence*

COPY EDITORS
Lauren Stickler *Chief*, Susan Colwell, Judy Connors-Tenney, Jeff Edmonds, Nancy Hayes, Cathy Kingery, Margaret A. Richard, Warren Williamson

EDITORIAL ASSISTANTS
Peggy Dunham *Office Manager*, Linda C. Ryan, June N. Sheldon, Lynn Susan Valley

ART
Nancy Rice *Director*, Joseph A. Gallagher *Assistant Director*, Jan Muller *Assistant*, Alan Easton *Technical Artist*

PRODUCTION
David R. Anderson *Director*, Virginia Reardon *Senior Editorial Production Coordinator*, Denise Chartrand *Editorial Production Coordinator*, Michael J. Lonsky *Editorial Production Coordinator*

TYPOGRAPHY
Sherry Fiske *Systems Manager*, Donna Sweeney *Applications Manager*, Christa Patterson

ADVERTISING/PRODUCTION (603) 924-6448
Lisa Wozmak *Director*, Lyda Clark *Senior Account Coordinator*, Karen Cilley, Linda Fluhr, Jeanne Gatcombe, Brian Higgins, Rod Holden, Wai Chiu Li *Quality Control Manager*, Julie Murphree *Advertising/Production Coordinator*

ADMINISTRATION
Donna Nordlund *Publisher's Assistant*

MARKETING COMMUNICATIONS
Horace T. Howland *Director*, Pamela Petrakos-Wilson *Promotion Manager*, Wilbur S. Watson *Marketing Services Manager*, Dawn Matthews *Public Relations Manager*, Lisa Jo Steiner *Marketing Assistant*, Stephanie Warnesky *Marketing Art Director*, Sharon Price *Associate Art Director*, Julie Perron *Market Research Analyst*

PLANNING AND RESEARCH
Michele Perron *Director*
Faith Kluntz *Copyrights Coordinator*, Cynthia Damato Sands *Reader Service Coordinator*

FINANCIAL SERVICES
Philip L. Penny *Director of Finance and Services*, Kenneth A. King *Business Manager*, Christine Monkton *Assistant*, Marilyn Haigh, Diane Henry, JoAnn Walter, Jaime Huber

CIRCULATION
Dan McLaughlin *Director*
James Bingham *Newsstand Sales Manager*, Vicki Weston *Assistant Manager*, Karen Desroches *Distribution Coordinator*, Donna Healy, *Direct Accounts Coordinator*, Louise Menegus *Back Issues*

PERSONNEL
Patricia Burke *Personnel Coordinator*, Beverly Goss *Receptionist*

BUILDING SERVICES
Tony Bennett *Manager*, Cliff Monkton, Mark Monkton, Agnes Perry

BIX BYTE INFORMATION EXCHANGE

DIRECTOR
Stephen M. Laliberte

EXECUTIVE EDITOR
George Bond

ASSOCIATE EDITOR
Tony Lockwood

MICROBYTES DAILY
D. Barker *Coordinator, Peterborough*, Rich Malloy *New York*, Gene Smarte *Costa Mesa*, Nicholas Baran *San Francisco*, Rick Cook *Phoenix*, Frank Hayes *San Francisco*, Jason Levitt *Austin, TX*, Larry Loeb *Wallingford, CT*, Brock N. Meeks *La Mesa, CA*, Stan Miastkowski *Peterborough*, Wayne Rash Jr., Sue Rosenberg *Washington, DC*, David Reed *Lexington, KY*

GROUP MODERATORS
David Allen *Applications*, Frank Boosman *Artificial Intelligence*, Leroy Casterline *Other*, Marc Greenfield *Programming Languages*, Jim Howard *Graphics*, Gary Kendall *Operating Systems*, Steve Krenek *Computers*, Brock N. Meeks *Telecommunications*, Barry Nance *New Technology*, Donald Osgood *Computers*, Sue Rosenberg *Other*, Jon Swanson *Chips*

BUSINESS AND MARKETING
Patricia Bausum *Secretary*, Denise A. Greene *Customer Service*, Brian Warnock *Customer Service*, Tammy Burgess *Customer Credit and Billing*

TECHNOLOGY
Clayton Lisle *Director, Business Systems Technology, MHIS*, Jack Reilly *Senior Business Systems Analyst*, Bob Dorobis *Business Systems Analyst*, Fred Strauss *Senior Business Systems Analyst*

PUBLISHER/GROUP VICE PRESIDENT
J. Burt Totaro

ADVERTISING SALES
Dennis J. Riley *Director*, **(603) 924-9281**
Sandra Foster *Administrative Assistant*

NEW ENGLAND
ME, NH, VT, MA, RI, ONTARIO, CANADA & EASTERN CANADA
John C. Moon **(617) 262-1160**

ATLANTIC
NY, NYC, CT, NJ (NORTH)
Leah G. Rabinowitz **(212) 512-2096**
(203) 968-7111

EAST
PA, KY, NJ (SOUTH), MD, VA, W.VA, DE, DC
(215) 496-3833

SOUTHEAST
NC, SC, GA, FL, AL, TN
Thomas Tolbert **(404) 252-0626**

MIDWEST
IL, MO, KS, IA, ND, SD, MN, WI, NE, IN, MI, MS, OH
Bob Denmead **(312) 751-3740**

Jennifer L. Bartel *Western Regional Sales Manager*, **(214) 644-1111**

SOUTHWEST, ROCKY MOUNTAIN
CO, WY, OK, TX, AR, LA
Karl Heinrich **(713) 462-0757**

SOUTH PACIFIC
SOUTHERN CA, AZ, NM, LAS VEGAS
Jack Anderson **(714) 557-6292**
Tom Harvey **(213) 480-5243**

NORTH PACIFIC
HI, WA, OR, ID, MT, NORTHERN CA, NV (except LAS VEGAS), UT, WESTERN CANADA
Mike Kisseberth **(415) 362-4600**
Bill McAfee **(415) 349-4100**

TELEMARKETING
L. Bradley Browne *Director*
Susan Boyd *Administrative Assistant*

BYTE BITS (2x3)
Dan Harper **(603) 924-6830**

THE BUYER'S MART (1x2)
Mark Stone **(603) 924-3754**

REGIONAL ADVERTISING SECTIONS
MID-ATLANTIC, METRO NY & NEW ENGLAND, SOUTHERN CALIFORNIA
Elisa Lister **(603) 924-6830**

MIDWEST, PACIFIC NORTHWEST, METRO NY & NEW ENGLAND
Scott Gagnon **(603) 924-6830**

SOUTHEAST, SOUTHWEST
Liz Coyman **(603) 924-9281**

BYTE DECK MAILINGS
National
Ed Ware **(603) 924-6166**

A/E/C COMPUTING DECK
COMPUTING FOR ENGINEERS DECK
Mary Ann Goulding **(603) 924-9281**

INTERNATIONAL ADVERTISING SALES STAFF
See listing on page 248.

EDITORIAL AND BUSINESS OFFICE:
One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.
West Coast Branch Offices: 425 Battery St., San Francisco, CA 94111, (415) 954-9718; 3001 Red Hill Ave., Building #1, Suite 222, Costa Mesa, CA 92626, (714) 557-6292.
New York Branch Editorial Office: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.
BYTEnet: (617) 861-9764 (set modem at 8-1-N or 7-1-E; 300 or 1200 baud). **Fax:** (603) 924-7507. **Telex:** (603) 924-7861.
SUBSCRIPTION CUSTOMER SERVICE: Non-U.S. (201) 837-1315; inside U.S. (outside NJ) 1-800-423-8272; (inside NJ) 1-800-367-0218.

Officers of McGraw-Hill Information Services Company: President: Walter D. Serwatka. Executive Vice Presidents: Kenneth E. Gazzola, Aerospace and Defense; Ira Herenstein, Computers and Communications; Russell C. White, Construction; Robert P. McGraw, Healthcare; Brian H. Hall, Legal. Senior Vice Presidents–Publishers: Laurence Altman, Data Communications; David J. McGrath, Engineering News-Record. Senior Vice Presidents: Robert D. Daleo, Finance; Michael J. Koeller, Human Resources. Group Vice Presidents: J. Burt Totaro, BYTE; Norbert Schumacher, Energy/Process Industries. Vice Presidents: George Elsinger, Circulation; Julia Lenard, Systems Planning and Technology.

Officers of McGraw-Hill Inc.: Joseph L. Dionne, Chairman and Chief Executive Officer; Robert N. Landes, Executive Vice President, General Counsel, and Secretary; Robert J. Bahash, Executive Vice President and Chief Financial Officer; Shel F. Asen, Senior Vice President, Manufacturing; Frank D. Penglase, Senior Vice President, Treasury Operations; Ralph R. Schulz, Senior Vice President, Editorial.

BYTE and BYTE are registered trademarks of McGraw-Hill Inc.

DOS system running Lotus 1-2-3

THIS IS AN IBM PS/2 MODEL 80 RUNNING DOS

Under DOS, this PS/2™ is a powerful 80386-based single-tasking, single-user computer that can run thousands of DOS applications. In 16-bit, 8086 mode.

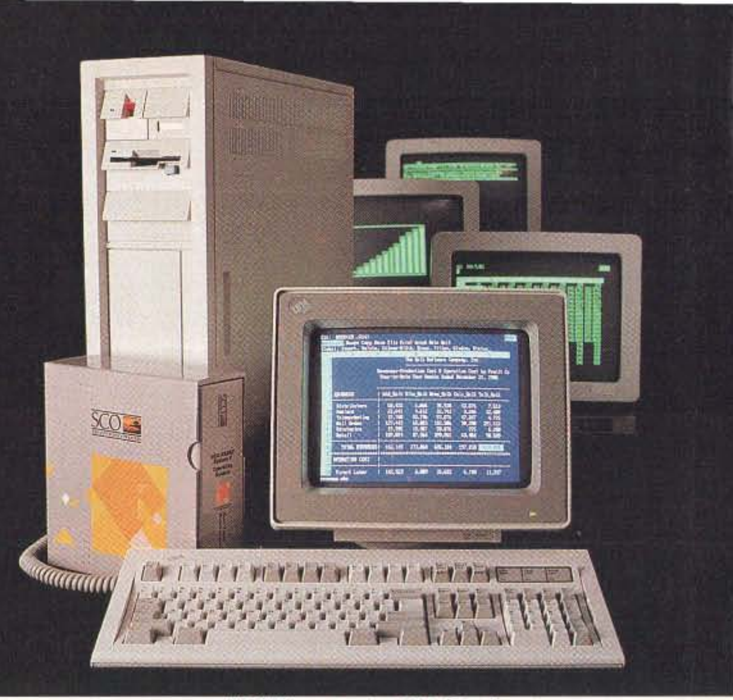
One at a time.

When OS/2™ software becomes available, the PS/2 can become a multitasking, single-user computer running in 16-bit, 286 mode that can also single-task those DOS applications under OS/2.

One at a time.

With DOS or OS/2, the PS/2 will support one user.

	1 user (DOS)	1 user (OS/2)
Cost per system**:	$12,389	$12,594
Cost per user:	**$12,389**	**$12,594**



SCO XENIX system running SCO Professional

THIS IS AN IBM PS/2 MODEL 80 RUNNING SCO XENIX

Under SCO XENIX,® this PS/2 becomes a powerful 80386-based multitasking, multiuser computer that can run thousands of XENIX applications. In full-tilt, 32-bit, 386 mode.

Many at a time.

And using SCO VP/ix,™* the PS/2 can multitask DOS applications under SCO XENIX.

Many at a time.

With SCO XENIX, the PS/2 will support one user.
Or 9 users. Or even 33 users.

And it can do all that today because you can get SCO XENIX for the PS/2—*now!*

	1 user	9 users	33 users
Cost per system**:	$14,559	$19,726	$40,402
Cost per user:	**$14,559**	**$2,192**	**$1,224**

SCO XENIX System V and the SCO XENIX family of software solutions are available for all industry-standard 8086-, 80286-, and 80386-based computers, and the IBM® Personal System/2™ Models 50, 60, and 80.

SCO™
THE SANTA CRUZ OPERATION

(800) 626-UNIX (626-8649)
(408) 425-7222
FAX: (408) 458-4227
TWX: 910-598-4510 SCO SACZ
uucp: ...decvax!microsoft!sco!info!

Circle 195 on Reader Service Card

---

*SCO VP/ix available as separate product.

Cost comparisons are based on most recently published U.S. domestic suggested list prices. **Cost model: Base machine: IBM PS/2 Model 80, 70Mb disk, 1Mb RAM, IBM 8512 color monitor, 1Mb additional IBM RAM, IBM ProPrinter XL,® **1-user DOS system:** Base machine, plus DOS 3.3, WordPerfect 4.2, Lotus® 1-2-3,® dBASE III PLUS.® **1-user OS/2 system:** 1-user DOS system; substitute OS/2 for DOS. **1-user SCO XENIX system:** Base machine, plus SCO XENIX 386 for PS/2, SCO VP/ix, SCO Lyrix® (word processing), SCO FoxBASE+™ (dBASE III PLUS workalike), SCO Professional™ (1-2-3 workalike). **9-user SCO XENIX system:** 1-user SCO XENIX system, plus intelligent 8-user multiport card, 8 IBM 3151 ASCII terminals. **33-user SCO XENIX system:** 9-user SCO XENIX System, plus 3 more intelligent 8-user multiport cards, 24 more IBM 3151 ASCII terminals, 4 Mb additional RAM, additional 70Mb disk.

IBM and ProPrinter XL are registered trademarks and Personal System/2, PS/2 and OS/2 are trademarks of International Business Machines Corporation. • Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation. • dBASE III PLUS is a registered trademark of Ashton-Tate. XENIX is a registered trademark of Microsoft Corporation. • VP/ix is a trademark of INTERACTIVE Systems, Inc. • Lyrix is a registered trademark and SCO Professional is a trademark of The Santa Cruz Operation, Inc. • FoxBASE+ is a trademark of Fox Software, Inc. 10/87
©1987 The Santa Cruz Operation, Inc., 400 Encinal Street, P.O. Box 1900, Santa Cruz, CA 95061

The Santa Cruz Operation, Ltd., 18 Noel Street, P.O. Box 4YN, London W1A 4YN United Kingdom, +44 1 439 2911, (FAX): +44 1 637 9381, TELEX: 917372 SCO LON

TWO ROADS

These days, there's more than one path to PC power

Recently, I was driving on Route 128 in Boston, the heart of Silicon Valley East. Several large semitrailers passed me, with other trucks and passenger cars following in their wake. The other vehicles were "drafting"—letting the first big truck cut a path for them and taking advantage of lowered wind resistance and improved mileage. It's a dangerous habit, especially if the truck in the lead decides to make a sudden stop or turn.

For the last several years, IBM has been the "lead truck" in the computer industry, barreling down the PC highway with a host of PC-compatible manufacturers trailing behind. The rest of us have been following somewhere further back in the distance. As we've traveled along, the road has been continuously upgraded and improved, from PC Road to the XT Expressway and then to the AT Highway—no dramatic twists and turns, but the ride hasn't been too bumpy, and we've been getting increasingly better mileage.

Then, in 1987, IBM took a sudden detour onto a new superhighway, Route PS/2. The clone manufacturers, not used to high-speed turns, gulped and continued on down the AT Highway, led by Compaq.

IBM, looking in its rearview mirror, figured that it had finally shaken the other entries from its tail. A year later, however, Big Blue may be getting a little nervous: If hardly *anybody* follows you, maybe you've taken a wrong turn.

Meanwhile, Compaq and the rest of the compatible convoy have found that the AT Highway (which has merged with Route 386) continues to be broad and well paved, and stretches toward the horizon with no distinct end in sight.

Move on Down the Road

So, along come the rest of us, with a choice to make: Do we follow IBM down Route PS/2, or do we stay on Route AT/386 and hope that the clone makers know where they're going? Of course, the front-runners aren't making things any easier for us, what with companies like Tandy and Dell selling both AT- and PS/2-style machines.

Even IBM, disappointed with sales of the PS/2, seems ready to plant a foot firmly in each path and attempt to bridge the gap Colossus-style; by the time you read this, IBM will have announced a new AT-based PS/2. Even the title of this *IBM Special Edition* is an indicator of the current situation; for the first four years, we called our annual IBM issue *Inside the IBM PCs*. Times have changed.

At the same time, other computing avenues are opening up. Unix, long the silent player in the microcomputer world, suddenly looks like a serious contender for the operating system of the future. The Macintosh and its heirs continue to make inroads into the market for "serious" heavy-duty applications. Steve Jobs' powerful NeXT machine—with its 68030 processor, 1120- by 832-pixel resolution, and read/write optical drive—could give the Mac and PS/2 a run for their money in the workstation race. And Amiga and Atari machines are far from running on empty. All this makes the computer industry a lot more volatile—and a lot more exciting.

All the Difference

The articles in this *IBM Special Edition* reflect the dual-road nature of IBM and compatible computing. You'll find articles that deal with the PS/2 and OS/2 alongside those that discuss DOS, the AT bus, and software alternatives to OS/2. We're not taking anything for granted. Neither should you.

Robert Frost took "the road less traveled," and that made all the difference in his journey. Whether you take the PS/2 route or the AT route, you'll find yourself in plenty of traffic, so you probably can't go wrong—and at the speed we're moving these days, that's no small comfort.

—Kenneth M. Sheldon
Senior Technical Editor
(BIX name "ksheldon")

ILLUSTRATION: ROB COLVIN © 1988

8 New Reasons To Buy ARTIST™

1. Arris
2. ANVIL-5000pc
3. AutoSolid
4. X-Windows
5. CADKEY
6. Hoops
7. VersaCAD
8. Art Gallery

Plus Ten Well-Known Old Ones

1 **Highly Software Compatible:** An impressive list of over 200 graphic software products support the ARTIST™ Series. CAD, image processing and desktop publishing just begin the list of ARTIST applications.

2 **Vast Product Line:** The ARTIST Series includes 20 graphic controllers that range in resolution from 800 x 600 to 1664 x 1200. They display up to 16.7 million simultaneous colors and use Hitachi, TI and NEC graphic microprocessors to handle complex drawing commands.*

3 **Single Screen Options:** VGA, EGA, and CGA modules give you single screen workstations.* At the same time, they allow you to run popular software packages that support IBM graphic standards.

4 **PC & MC Bus Compatible:** We offer ARTIST graphic controllers for the IBM® PC/XT/AT, IBM PS/2 Micro Channel™ and compatibles. (MacIntosh II products to be offered soon.)

5 **Design Leadership:** Control Systems was the first to produce a high performance graphic controller for the original IBM PC in 1982 and we repeated that effort in 1987 for the IBM PS/2s.

6 **Peak Performance:** We combine ARTIST controllers with ARTIST software drivers to give you fast, feature-packed graphic subsystems that few can match. Our ARTIST GT™ display list processing drivers give you instant zooms, birds-eye-views, transparent pans, and more.

7 **High Customer Satisfaction:** Our in-house testing procedures guarantee you smooth installation and operation. Less than 1% of ARTIST controllers are returned for repair.

8 **Development Tools:** We offer developer's toolkits for PGL, DGIS, X-Windows, and Hoops. Each has a complete set of graphic primitives to speed creation of new software applications.

9 **Immediate Customer Support:** Call us on our hotline and get same day customer service for all your ARTIST products. We've been told it's the best in the business.

10 **Years of Experience:** 6 years of graphics experience go into the development of new hardware and software products. As long as you own your ARTIST graphic workstation, Control Systems will be there to support you and offer you advanced ARTIST products.

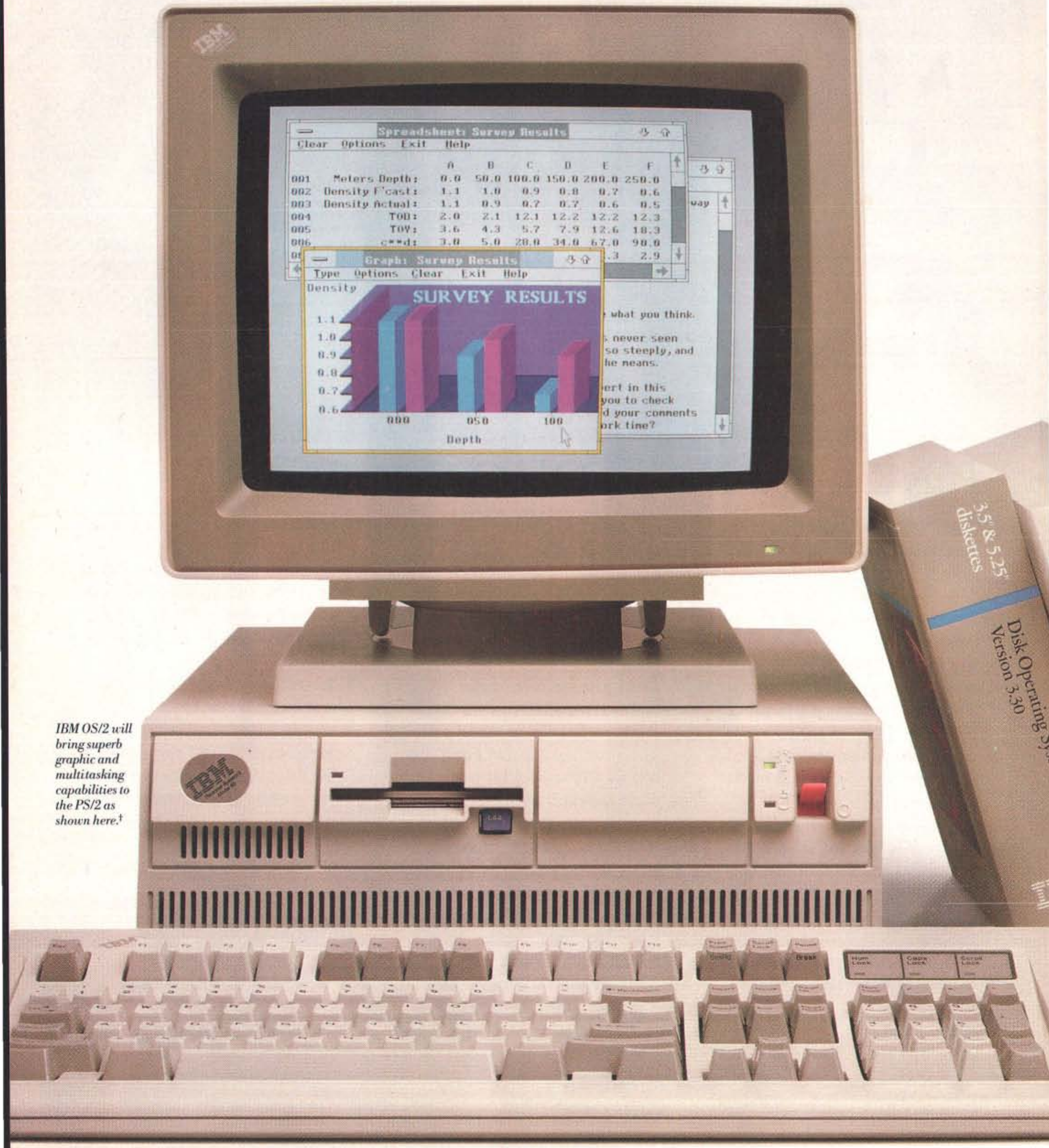
Control Systems™
P.O. Box 64750 St. Paul, MN 55164
or call
1-800-826-4281
In Canada call
1-800-543-6523

Circle 57 on Reader Service Card (DEALERS: 58)

*Note: ARTIST controller features vary from product to product. Specifications are subject to change.

ARTIST and ARTIST GT are trademarks of Control Systems, Inc. IBM is a registered trademark and PS/2 and Micro Channel are trademarks of International Business Systems. Images courtesy of MCS, CADKEY, VersaCAD, Ithaca Software, Autodesk, Sigma Design, AT&T GSL. ©Copyright 1988 Control Systems.

The best way to lea
through next Monda


IBM
Spreadsheet: Survey Results
Clear Options Exit Help
A B C D E F
001 Meters Depth: 0.0 50.0 100.0 150.0 200.0 250.0
002 Density F'cast: 1.1 1.0 0.9 0.8 0.7 0.6
003 Density Actual: 1.1 0.9 0.7 0.7 0.6 0.5
004 TOD: 2.0 2.1 12.1 12.2 12.2 12.3
005 TOV: 3.6 4.3 5.7 7.9 12.6 18.3
006 c**d: 3.0 5.0 28.0 34.0 67.0 98.0
Graph: Survey Results
Type Options Clear Exit Help
Density
SURVEY RESULTS
1.1
1.0
0.9
0.8
0.7
0.6
000
050
100
Depth
way
what you think.
never seen
so steeply, and
he means.
ert in this
you to check
d your comments
ork time?
IBM
3.5" & 5.25" diskettes
Disk Operating Sys
Version 3.30

IBM OS/2 will bring superb graphic and multitasking capabilities to the PS/2 as shown here.†

ears ahead and get t the same time.

Every business person worth his or her salt knows you have to prepare for the future. They also know the only way to get to the future is by getting a grip on business now.

That is precisely the point of the IBM® Personal System/2® family.

In fact, the real beauty of the PS/2® design is that it has enabled us to satisfy many of your immediate needs, while still focusing on the bigger picture.

For improving performance, there's no time like the present.

The PS/2 was designed to bring advanced technology to your desk now.

It runs DOS applications you're running now, like Lotus® 1-2-3® spreadsheet and DisplayWrite™ 4 word processing program.

And it runs them faster—from 117% to more than 850% faster, in tested applications,* depending on the program and the model you choose.

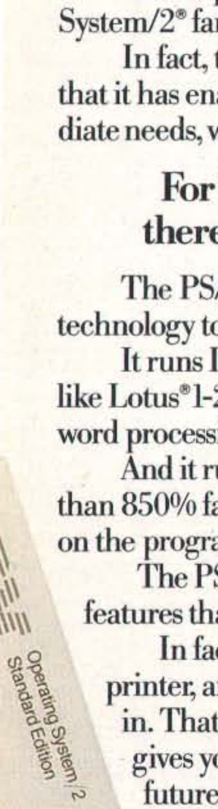
The PS/2 family also gives you more standard features than other systems.

In fact, graphics, along with communication, printer, and pointing device ports, are built right in. That can save you money later on. And it gives you the convenience you'll need in the future. Right now.

All of those features were designed to satisfy your present need for power and graphics. And they do. Which is why the Personal System/2 family is selling faster than any computers in history.

But satisfying your current needs was only part of the plan.

The PS/2 was also intended to offer you an entirely new way of protecting the life of your investment.



IBM puts the future of computing in your hands.

If the IBM PS/2 is the best way to get a handle on business today, the PS/2 combined with the IBM Operating System/2™ program could completely redefine your ideas about computing in the future.

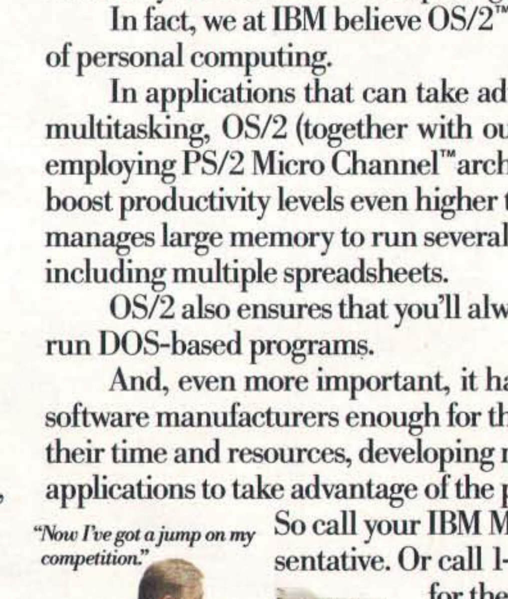
In fact, we at IBM believe OS/2™ *is* the future of personal computing.

In applications that can take advantage of multitasking, OS/2 (together with our models employing PS/2 Micro Channel™ architecture) can boost productivity levels even higher than DOS. It manages large memory to run several jobs at once, including multiple spreadsheets.

OS/2 also ensures that you'll always be able to run DOS-based programs.

And, even more important, it has impressed software manufacturers enough for them to invest their time and resources, developing many new applications to take advantage of the power of OS/2.

So call your IBM Marketing Representative. Or call 1-800-447-4700 for the name of your nearest IBM authorized dealer. Learn more about the IBM PS/2 and OS/2. And learn how to make your day-to-day operation more efficient while keeping a close eye on the bigger picture.



"Now I've got a jump on my competition."

IBM. The Bigger Picture

---

*Based on performance test results published in the April, 1987 and January, 1988 issues of *PC Digest*, comparing the PS/2 Models 30, 50, 60 and 80 to the IBM PC XT-089, running Lotus 1-2-3 and DisplayWrite 4. Actual results may vary. †This simulated screen shown was developed using the IBM Storyboard Plus program. IBM, Personal System/2 and PS/2 are registered trademarks; PC XT, Operating System/2, OS/2, Micro Channel and DisplayWrite are trademarks of IBM Corporation. Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation. © IBM 1988.

ILLUSTRATION: JOE GAST © 1988

COMPUTING AT CHAOS MANOR ■ Jerry Pournelle

PROBING THE STATE OF THE ART

Jerry teaches his scanner a few tricks, and he gets a new mouse and a wonderful printer

Special supplements are supposed to provide a good opportunity to talk about the state of the art. I've got only one problem: I don't know what the state of the PC art is.

The PC world is in a thorough state of flux just now. We don't even know what bus will be used in the future. IBM is very disappointed in PS/2 sales, particularly sales of machines using the new Micro Channel bus. The company makes a big thing about having shipped 2 million PS/2 systems, but "shipped" isn't sold. Many of those machines are sitting in warehouses. It's impossible to get the real sales figures, but they're a long way shy of 2 million. So it goes. Meanwhile, no other major company has done anything with the Micro Channel. We sure can't call the PS/2 the state of the art. It may be, but it may also be a dead end.

On the other hand, while no important third party has adopted the Micro Channel bus, there's no standard 32-bit bus either. Zenith went one way, Compaq another, and Intel yet another. Cheetah, a relative newcomer, has developed a motherboard and bus that many, including me, consider the best of the lot. My Cheetah 386 runs at 20 MHz, but it would run at 25 MHz and possibly at 30 MHz if I had the higher-rated chips. There are also about a dozen other advanced 80386 systems.

The point is that although I consider the 80386/80387 the real state-of-the-art chip set, we're still left with a very real problem: whose 80386 bus? No one company is going to do everything well. The microcomputer industry makes its biggest advances through small companies developing add-ons to standard systems. Until someone's bus becomes a standard, we're not going to see too many real advances in 32-bit add-on boards.

I don't want to be an alarmist. Except for the Micro Channel, all 32-bit 80386 systems use the standard IBM PC AT (16-bit) bus as a starting point. The AT bus is a subset of all the 32-bit 80386 machines, and they'll all run 16-bit add-on boards. There's no shortage of developers of 16-bit boards. Moreover, at the moment, the main use of 32-bit boards is for 32-bit memory, and the various companies that make 32-bit 80386 machines all sell memory cards to go with their systems. There's no crisis. But until we do get some standards, there won't be the incentive for small start-ups to develop innovative 32-bit hardware applications.

Operating-System Wars

We're also unsure about the operating system of the future. IBM recently revised sharply downward the sales estimates of OS/2 penetration: instead of predicting 75 percent acceptance among AT and PS/2 users, they're now expecting no more than 25 percent to 30 percent. This can affect the amount of hype and promotion IBM puts into OS/2. As a result, not even IBM knows what the operating system of the future will be.

For the moment, the contenders are OS/2, OS/3 (which works only on 80386-compatible machines), one or another brand of Unix, and good old DOS itself. Note that even if IBM goes for Unix, there will still be divisions within the microcomputer community. The Unix faction within IBM wants to promote AIX, Big Blue's own brand of Unix, rather than AT&T's. There's even a real question of whether this is serious marketing or merely a ploy to distract attention from AT&T's "real" Unix.

Assuming IBM seriously turns from OS/2 to Unix, it's still not clear what will happen. By developing their own brand of Unix, IBM will be going head to head with AT&T. AT&T has the most experience with Unix and thus presumably has a head start. AT&T has great resources, including Bell Labs and lots of money. On the other hand, IBM has terrific marketing, while AT&T's present team couldn't market eternal life.

The dark horse on our list is OS/3. Acceptance of that will depend almost entirely on the timely appearance of the 80386SX chip, formerly known as the P9; the chip (well, actually it's a little daughterboard, but you can think of it as a chip) goes in the 80286's socket and turns all those AT machines out there into 80386s. Of course, it doesn't *really* do that, since 80286 machines have only a 16-bit bus, while real 80386s can work with 32 bits; but the 80386SX will let 80286 machines execute 80386 code, meaning that an operating system designed to use the 80386's many advances over the 80286 is easier to write and more useful than one that must work with all the different steps and revisions of the 80286.

I can't draw any conclusions from all this. I can say that for me, the current state of the art is an 80386 machine using Quarterdeck's DESQview under DOS. It's what I'm running; if I decide to change, it will be from DESQview to Microsoft Windows/386. I haven't seen anything that tempts me to make any other changes.

Scanners Live in Vain

When I began using microcomputers, I'd been writing for some time and had many books in print. I've since had two of them keyed into machine-readable form, but many more exist only in printed form. My books generally stay in print, but once in a while one gets sufficiently dated that it ought to be revised before reissue. That can be a problem. I'm used to working with computers now, and I don't

continued

much like doing pen-and-ink revisions on photocopies of typeset books. Rekeying the whole book is usually impractical. By the time I can get it done, the deadline for turning in the revisions is past. What I need is a gizmo that will read a printed copy of the book itself.

That kind of scanning system is called an optical character reader, or OCR, and I recently got a state-of-the-art system.

The hardware is the Hewlett-Packard ScanJet. It looks like a small copy machine, complete with a glass scanning plate, where you put documents up to legal size. (I think larger-size machines are available.) You can also get an automatic document feeder attachment. The ScanJet comes with an 8-bit (short slot) interface card you install in your PC, and software to let the computer know how to find the device.

The ScanJet installation documents are remarkably clear and concise. Of course, there's also the standard legalese that informs you that Hewlett-Packard doesn't warrant the documents to contain ink on paper, much less useful information.

Once it's set up, you can use the ScanJet's Scanning Gallery software to capture images into disk files. For that matter, you can use the ScanJet as a rather odd sort of copier. We connected the AT to a Kyocera F-3010 laser printer emulating a Hewlett-Packard LaserJet Series II, put a picture (actually a page of the ScanJet manual) in the ScanJet, and presto! Out came quite a good copy of the manual page, complete with diagrams.

Scanning Gallery works under Microsoft Windows. You don't need Windows to make it work; a run-time Windows program comes with Scanning Gallery. The program is nifty. You can get a preview scan of your document, then show the program just what part you want to clip out and put into a file. You can also dither around with the image, making it lighter or darker. You can paste it into some other document. Scanning Gallery images can be converted into PC Paintbrush and Microsoft Paint file formats.

Of course, all you have is an *image* of your document. The computer hasn't *read* it, and it doesn't understand that this particular image contains words and ASCII characters. It's just an image.

Still, if all you want is to get images into files so you can paste them into black-and-white documents, the ScanJet and Scanning Gallery will do the job quickly and painlessly. The ScanJet works fine with PageMaker, Ventura Publisher, and, I have no doubt, other desktop publishing systems. If you're seriously into desktop publishing, you will sooner or later want a scanner, and I can heartily recommend the ScanJet.

Here, Spot

We'll probably use the ScanJet to build up a library of images I can use as "visual rewards" when I put together the final version of Mrs. Pournelle's reading instruction program; but that isn't why we wanted it. I got the ScanJet because I understood that Flagstaff Engineering had software that would let me use it as an OCR to read in my books. Indeed, the ScanJet came on loan from Flagstaff. An OCR program doesn't just bring in *images* of text; it actually *reads* the document and puts it into a file you can then transfer to your word processor.

Flagstaff's Spot is a "trainable" OCR program, which means that you can teach it to recognize the letters in different type fonts. As Spot learns, it builds a

continued

PC TO MAINFRAME DATA INTERCHANGE SOLUTIONS

Telebyte offers high performance PC/nine track tape systems to solve any interchange requirement.

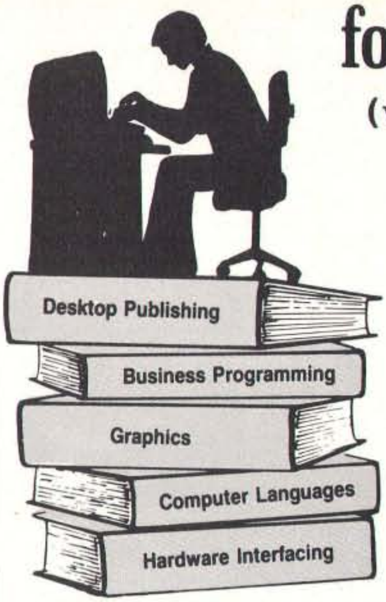
- True Start/Stop operation offers PC data transfer times comparable to hard disks.
- Full featured software packages with fully integrated DOS or XENIX Driver interfaces.
- PC/AT/386 subsystems available.
- All densities 200 BPI thru 6250 BPI, 7 and 9 track available.

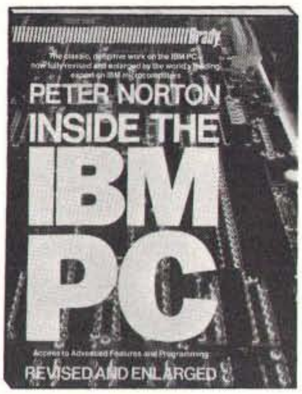
Contact us today at
Telebyte Technology
270 East Pulaski Road,
Greenlawn, NY 11740
(516)423-3232
(800)835-3298
TWX-510-226-0449
FAX(516)385-8184

TELEBYTE

Circle 224 on Reader Service Card

SELECT 5 BOOKS
for only $3.95
(values to $126.75)





9762P $21.95

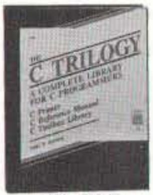
Membership Benefits • **Big Savings.** In addition to this introductory offer, you keep saving substantially with members' prices of up to 50% off the publishers' prices. • **Bonus Books.** Starting immediately, you will be eligible for our Bonus Book Plan, with savings of up to 80% off publishers' prices. • **Club News Bulletins.** 14 times per year you will receive the Book Club News, describing all the current selections—mains, alternates, extras—plus bonus offers and special sales, with hundreds of titles to choose from. • **Automatic Order.** If you want the Main Selection, do nothing and it will be sent to you automatically. If you prefer another selection, or no book at all, simply indicate your choice on the reply form provided. As a member, you agree to purchase at least 3 books within the next 12 months and may resign at any time thereafter. • **Ironclad No-Risk Guarantee.** If not satisfied with your books, return them within 10 days without obligation! • **Exceptional Quality.** All books are quality publishers' editions especially selected by our Editorial Board.

All books are hardcover unless numbers are followed by a "P" for paperback. (Publishers' Prices Shown)

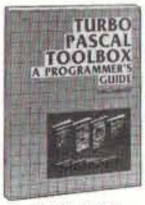
© 1988 THE COMPUTER BOOK CLUB® Blue Ridge Summit, PA 17294-0820

1540P $17.95

2907P $19.95



2890 $32.95
Counts as 2



2852P $17.95

When it's new and important in business or personal computing, The Computer Book Club has the information you need . . . at savings of up to 50% off publishers' prices!

The Computer Book Club®

Blue Ridge Summit, PA 17294-0820

Please accept my membership in The Computer Book Club® and send the 5 volumes listed below, billing me $3.95 plus shipping and handling charges. If not satisfied, I may return the books within ten days without obligation and have my membership canceled. I agree to purchase at least 3 books at regular Club prices (plus shipping/handling) during the next 12 months and may resign any time thereafter.

Name ______________________________

Address ______________________________

City ______________________________

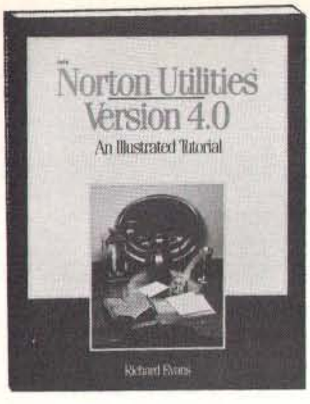
State/Zip ____________________ Phone ______________

Signature ______________________________

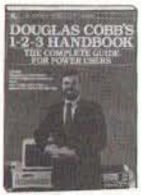
Valid for new members only. Foreign applicants will receive special ordering instructions. Canada *must* remit in U.S. currency. This order subject to acceptance by The Computer Book Club®.

Signature of parent or guardian required for all new members under 18 years of age. BYI-1088

Circle 52 on Reader Service Card

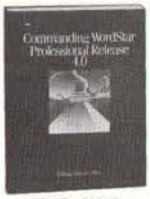


2929P $15.95



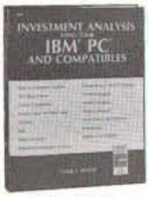
9779P $22.95

1939P $19.95



2983P $16.95

1968P $14.95

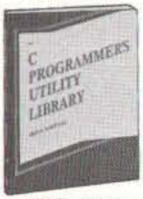


1859 $24.95

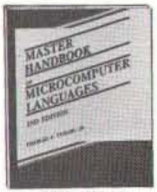
2870 $24.95

2877P $16.95

2729 $22.95



2855P $16.95

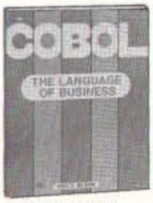


2893 $26.95
Counts as 2

2627P $17.95

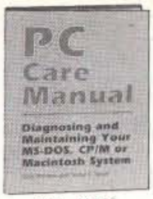
2892P $16.95

1860P $16.95



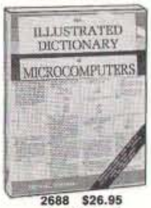
2690P $16.95

2948 $27.95

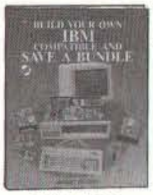

PC Care Manual
Diagnosing and Maintaining Your MS-DOS, CP/M or Macintosh System

2991 $24.95

2856P $18.95



2688 $26.95
Counts as 2

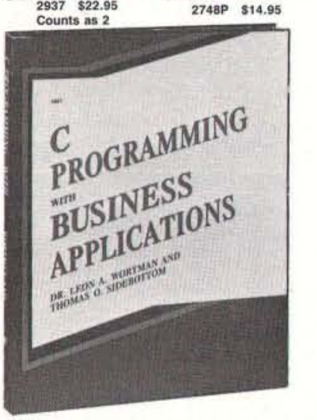


2831 $22.95

2879P $22.95

2937 $22.95
Counts as 2

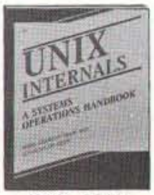
2748P $14.95


C PROGRAMMING WITH BUSINESS APPLICATIONS
DR. LEON A. WORTMAN AND THOMAS O. SIDEBOTTOM

2857 $25.95

IBM PC SHAREWARE PC-FILE, PC-WRITE, PC-TALK AND EXPRESS-CALC

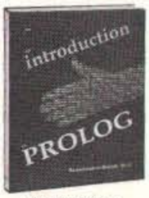
2841P $15.95



2951P $17.95

1848P $15.95

2620 $25.95



2682P $16.95

2939 $24.95

Diamond Scan 14
Auto-Tracking
800 x 600 pixels (digital, analog, monochrome)
330 x 500 pixels (composite NTSC)

Diamond Scan 20A
Auto-Tracking
800 x 600 pixels (digital, analog, monochrome)
1024 x 800 pixels (maximum)

Diamond Scan 16L
Auto-Tracking
1024 x 768 pixels (typical)
1280 x 1024 pixels (maximum)

Diamond Scan 20L
Auto-Tracking
Up to 1280 x 1024 pixels

Actual unretouched screen images

A Clear View To Monitor Qualit

font file for that particular type font; once that file is built, you can load it in at any time. Since it takes anywhere from a few minutes to several hours to train Spot to recognize a font, you should be careful to make *frequent* backups of the font file while the educational work is in progress; I managed to crash the system (my fault entirely) and lose an hour of work during my tests.

To use Spot, you must have some kind of scanner. Flagstaff's documents list the Canon IX-12 (with or without the Tall Tree Systems JRAM/JLaser board), the ScanJet, Panasonic FX-RS505 and FX-RS506, and Microtek MSF-300C and MSF-300G scanners as being acceptable. The PC you use must have either CGA (or EGA in CGA emulation) or Hercules-compatible monochrome graphics. Our generic AT clone has a genuine Hercules card running an Imtec 12-inch amber-screen monochrome monitor and works fine. You'll need at least 512K bytes of main memory. If your machine has a megabyte or more of Lotus/Intel/Microsoft Expanded Memory Specification 4.0 memory, Spot will know how to make use of it and can do some fancier tricks, but you don't need any expanded memory.

You'll also need a hard disk drive. Spot will run on a floppy disk drive–only system, but Flagstaff warns against doing that, since everything will be terribly slow.

Spot is quite easy to install, provided that you ignore the silly directions given in the manual. For reasons not clear to me, Flagstaff has built a complex Setup batch file to do a very simple job. In theory, Setup will copy the Spot disk files from disk A to your hard disk. In practice, it won't do it that easily; you're much better off creating a subdirectory and using DOS's `COPY` command to move the files. Then you can run Setup directly off the hard disk.

Spot comes with about a dozen font files. It's menu-driven, and while the manual sucks rocks, it really isn't hard to figure out how to do what you want. As a test, we loaded in the Letter Gothic 12-pitch Selectric font and put a test page written in that into the ScanJet.

The ScanJet lights came on (Spot controls the whole process), the AT clone thought to itself, and quickly there appeared, line by line, long lines of utter garbage. I stood there ruefully shaking my head. Mrs. Pournelle was more practical. She looked at how I'd put the paper into the ScanJet and turned it over. When we tried again, Spot read every letter.

The test page is laid out in multiple columns. There are ways to tell Spot how to store those columns in sequence so that the text file you're building reads continuously. Once we'd read the text image, I stored it all as an ASCII file, exited Spot, and read the file into a text editor. Voilà! Everything worked fine.

I changed test sheets and fonts, and fired it up again. Same result, perfect score again. On the third test sheet, Spot missed one letter, replacing it with the wrong character. When we looked at the original, we couldn't see anything different about the letter it missed—an *a*—but what the heck, missing one letter in three pages is plenty good enough. I was beginning to get excited.

Teaching Spot Tricks

It was clear that Spot could read just about any typescript ever devised. The acid test would be whether I could teach it

Circle 250 on Reader Service Card (DEALERS: 251)

Only one supplier of color monitors offers the widest selection of features and operating flexibilities in the market today.

That company is Mitsubishi Electronics.

Mitsubishi® delivers the reliability and performance that can meet your color information display requirements today as well as tomorrow. Larger screen sizes, truer colors, and optimum resolutions make your work easier—and far more productive.

Whether your requirements call for fixed-frequency graphics standards, like EGA and VGA, or multiple-frequency performance, Mitsubishi has the color monitor with the resolution and size to fit *your* specific needs. This includes the Diamond Scan Series of 14", 16" and 20" auto-tracking monitors, some with microprocessor-enhanced programmable display settings. All at very competitive prices.

To get a clear view of monitor quality and value, look to Mitsubishi.

For product information or nearest authorized Mitsubishi Electronics sales representatives, please call 1-800-556-1234, ext. 54M. In California, call 1-800-441-2345, ext. 54M. Mitsubishi Electronics America, Inc., Computer Peripherals Division, 991 Knox Street, Torrance, CA 90502, (213) 217-5732.

Mitsubishi Model	Screen Size (inches)	Horizontal Scan Frequency (kHz)	Mask Pitch (mm)	Compatibility/Resolution							
				NTSC	CGA	EGA	VGA Std.	VGA Ext.	Apple Mac II	1024 x 768 (48 kHz)	1280 x 1024 (64 kHz)
Diamond Scan 14 (AUM1381A)	14/13V	15.7 ~ 36 auto-tracking	0.31	•	•	•	•	•	•		
Diamond Scan 16L* (HL6605TK)	16/15V	30 ~ 64 auto-tracking	0.31				•	•	•	•	•
Diamond Scan 20A (HA3905ADK)	20/19V	15.7 ~ 36 auto-tracking	0.31		•	•	•	•	•		
Diamond Scan 20L* (HL6905TK)	20/19V	30 ~ 64 auto-tracking	0.31				•	•	•	•	•
XC1429C	14/13V	31.5	0.28				•				
XC1410C	14/13V	22 or 15.75	0.40		•	•					
XC1430C	14/13V	22 or 15.75	0.31		•	•					

*Microprocessor-enhanced programmable display settings

XC1429C
VGA Compatible
640 x 480 pixels

XC1410C/XC1430C
EGA Compatible
640 x 350 pixels

MITSUBISHI ELECTRONICS

See us at COMDEX Booth #1128

And Value.

© 1988 Mitsubishi Electronics America, Inc.
Mitsubishi is a registered trademark of Mitsubishi Electric Corp., Tokyo.

Screen images produced with permission from the following companies *(trademarked software package name follows company name)*: Autodesk, Inc. *(AutoShade)*; Computervision Corporation *(Personal Designer)*; Computer Friends, Inc. *(Modern Artist)*; SuperMac Software *(PixelPaint)*; Three D Graphics, Inc. *(Perspective)*; Microsoft Corporation *(Excel Version 2.0)*.

to read my printed books. Could it read kerned text? (Kerning is the typesetting technique of squeezing letters together so that their spacing overlaps, for example, *WA*.)

I got out *Exiles to Glory*, a science fiction adventure novel published by Ace Books in 1978. The book is theoretically still in print, but it's about time for a reissue. The book has stood up well, but if I had a machine-readable copy, I'd probably make a few revisions.

The first problem was how to lay the book into the scanner. Should I make a photocopy first, so that I'd have one page on each sheet, or should I open the book and lay it flat? The Spot manual said that I could tell the program to treat the two pages as columns, so I decided to use the book laid flat.

The next problem was headers. The book has running heads—my name on the left side, and *Exiles to Glory* on the right—and they're not in the same typeface as the rest of the text. I solved that problem by putting a narrow strip of tape across the top of the scanner's glass. That way, I could square off the top of the book to the top of the scanner window, but the scanner wouldn't be able to see that header at all.

It's easy to invoke Spot's teaching function. I did that and told it to save what it learned in a font file named Exile, laid the book on the scanner screen, and told Spot to have at it. The scan light came on. Spot reads the entire page image at one gulp; once the scan light goes off, you can remove the text from the scanner. Then the computer thinks for a while and shows you what it has seen.

The first thing it had seen were some tiny spots, clearly garbage. Once we were past those, Spot put up a magnified graphic image of the first line of text, with the first letter surrounded by a little box. I typed in what the letter was—as it happens, a *T*—and Spot went on to the next letter, and the next. Feeding Spot while it's learning a new alphabet can be tedious, but it's also exciting. Spot shows each new character (uppercase and lowercase letters, numerals, and punctuation marks) that it has learned in a little table at the bottom of the page, so you can tell which ones you still have to show it.

At first all Spot saw was single letters, but then it began to show two-letter combinations. It does that by expanding the little on-screen box; what Spot is saying is that it can't see any gaps between these letters, so it thinks this is just a single character. I typed in the two letters (*fi*, as I recall) and told Spot to continue.

After a while, Spot had learned most of the letters and a number of two-letter and even three-letter combinations. At this point, I set the Spot "guessing level" so that the program would skip over all the letters it was confident it knew and show only those it was uncertain about. Now the work went even faster.

I saved my work and scanned another page—and disaster struck.

Spot doesn't understand about lines. Spot's little box showing me what the program was looking at enclosed the lower chunk of a letter on one line and the upper half of another letter on the line below. This sure wasn't anything I wanted Spot to learn, so I told it to skip it. No good. It was obsessed with the notion that the "center of gravity" of my text was between the lines.

I decided maybe the book wasn't prop-

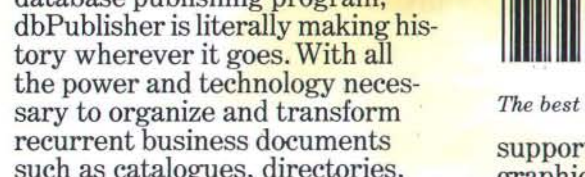
continued

We'd like to announce another historic event.

INTRODUCING dbPUBLISHER

As the world's first true database publishing program, dbPublisher is literally making history wherever it goes. With all the power and technology necessary to organize and transform recurrent business documents such as catalogues, directories, price lists and reports into beautifully typeset pages.

And with all the compatibility needed to provide access to virtually all the data in a user's world. dbPublisher runs with almost every major PC-based database, spreadsheet, word processing, and graphics program in popular use today. Over 120 in all, including many mutually incompatible programs.



Be remembered for what you do.

MAKE SOME HISTORY OF YOUR OWN

dbPublisher can help you turn raw data into the best looking and easiest to read printed documents you or your customers have ever seen. And do it quickly and efficiently, thanks to modern, "point and click" icon mouse support, plus multi-layered, graphics-oriented screens every step of the way.

A1B201720

The best bar codes — bar none.

Page composition is very fast, and everything can be previewed full-size on your screen. There's a complete library of user-definable report formats as well as many automatic text and image styling features. And dbPublisher also includes a full selection of mathematical, financial, date/time and logical functions.

THE MANY FACES OF dbPUBLISHER

Choose from over 1000 fonts, and take advantage of sophisticated typographical controls, including precise spacing, indents, kerning and leading. You can add multiple headers and footers, as well as ruled tables with automatic table layout. dbPublisher can also integrate text and graphics, and even generate bar codes. And it supports SGML-style mark-up tags, and prints flawless form letters and mailing labels.

dbPublisher runs with any IBM AT, P/S 2 or 100% compatible with 640K, a mouse and a hard disk with a minimum of 20MB. In addition, it supports the leading dot matrix and laser printers, including HP LaserJet and the "PostScript" language, as well as a number of typesetting machines.

AAAAAAA

We've got just your type.

PRICED TO ROLL

You might think that something with so much to offer could easily carry a pretty high sticker. No need to worry, because at $695 for the single-user version ($895 network), we think you'll agree: dbPublisher's price is positively prehistoric.

Call us today at *(602) 870-7667* and ask about dbPublisher. It could help you carve out a new chapter in the history of your business.

See us at COMDEX, Bally's 1524

db PUBLISHER

A product of Digital Composition Systems
1715 W. Northern Avenue, Phoenix, AZ 85021
Tel. (602) 870-7667

Registered and unregistered trademarks used herein are those of their respective owners.

Circle 149 on Reader Service Card (DEALERS: 150)

Picture Permanent.

Brilliant Color Output With IBM® Compatibility.

If you're looking for an easy-to-use color printer that delivers fast, high quality color output, with full IBM compatibility, look at the G330-70 from Mitsubishi Electronics.

A built-in video interface enables the G330-70 to create a permanent copy on glossy paper or transparency film of any image viewed on your computer monitor.

With 150 dots per inch resolution, the G330-70 is ideally suited for presentation graphics, paint-type graphic art and PC CAD. It operates smoothly in several PC environments, including the IBM PC/XT/AT and compatibles, IBM PS/2™ or the Apple® Macintosh™ II. The G330-70 can print the screen displays from popular graphics boards, including CGA, EGA, VGA and Mac II.

For fast, bold, brilliant color output directly from your monitor, specify the Mitsubishi® G330-70. At a suggested retail price of $5900, the G330-70 offers the most convenient method for high quality color output.

For product information or nearest authorized Mitsubishi Electronics sales representatives, please call 1-800-556-1234, ext. 54R. In California, call 1-800-441-2345, ext. 54R. Mitsubishi Electronics America, Inc., Computer Peripherals Division, 991 Knox Street, Torrance, CA 90502, (213) 217-5732.

The G330-70 color thermal transfer printer produces a full-color 8½" x 11" page or transparency in about 80 seconds.

See us at COMDEX Booth #1128

MITSUBISHI ELECTRONICS

© 1988 Mitsubishi Electronics America, Inc.
Mitsubishi is a registered trademark of Mitsubishi Electric Corp., Tokyo.
IBM is a registered trademark of International Business Machines Corporation.
Apple is a registered trademark of Apple Computer, Inc.

Images printed with permission from the following companies *(trademarked software package name follows company name)*: Three D Graphics, Inc. *(Perspective)*; ZSoft Corporation *(PC Paintbrush Plus)*; Autodesk, Inc. *(AutoShade)*.

erly squared up in the reader, adjusted it, and scanned it again. This time, I didn't get that odd result until further down on the page, but it still happened.

There was another problem. In 1979, Ace didn't print on what you'd call high-quality paper. Sometimes the ink would run so that two letters not usually kerned would be ever so slightly run together. For example, the right-hand serif of the *a* in the combination *as* might barely touch the left serif of the *s*. Spot asks about this special case (as indeed it should and must), and then you have a dilemma.

Spot can learn only 250 characters. That's a lot, but it may not be enough. Consider that in all fonts there will be 52 uppercase and lowercase letters; 10 numerals; a dozen symbols, such as $, %, ^, &, and *; and another dozen punctuation marks. This uses up well over a hundred of your symbols before you can teach the program a single combination pair. There are another 75 or so common kerning pairs that have to be learned, so now we're up to 200, leaving no more than 50 we can waste on stuff like the *as* in my example above. How many ink-run cases could I afford to teach the program? I just had to guess which ones would be common.

I also kept getting the "multiple line" phenomenon I described above. Whenever it happened, it could be fixed only by moving the book around on the scanning plate and rescanning that page. Finally, we figured out what was happening: because the book was laid flat on the screen, the lines on each page weren't precisely in adjustment to each other. Get everything really square, and the problem goes away. Another remedy would be to define each page as a separate zone; I didn't do that, but it probably would have worked.

Eventually, I taught Spot the entire font that *Exiles to Glory* was printed in, plus all the kerning pairs and triplets I could find. Now we were ready to read in the book.

Alas, that was a disaster. Spot didn't recognize half the letters on the page. There would be a fair number of correct words and letters, then something like a group of squiggles, where each squiggle stood for from one to several letters. Recentering the page and scanning it again improved matters slightly, but the percentage recognized was still far too low. Spot lets you correct the page before you save it, but in the time it would take to make all those corrections, a good typist could have copied the whole page in the first place.

Well, all right, I thought. *Exiles to Glory* wasn't printed on very good paper. I'll take *Birth of Fire*, recently reprinted by Baen Books, and try that.

Alas, that produced just about the same result.

Finally, I took out a quality art book printed on slick paper and taught Spot that font. This time, things worked pretty well. There weren't many ink-run characters for the program to learn. After Spot had learned the font, we began to scan the book, and it got well over 90 percent correct; if that had been a book I wanted my computer to read, I'd have been able to use Spot to do it.

Actually, I wouldn't have used Spot on the art book, because the big art book had lots of graphics. Spot has a system for dealing with this. You can define zones in the scanned image: some areas will be text and should be scanned with

continued

LABELING SOFTWARE

For DOT MATRIX and Laser Printers

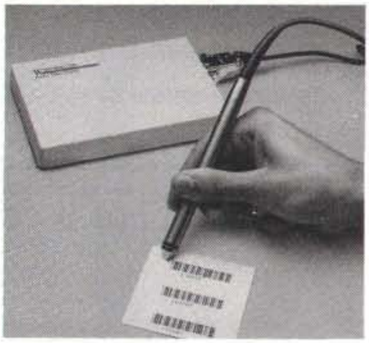
(Epson/IBM/Okidata/LaserJet)

- Labels for shelves, bins, inventory
- 13 text sizes readable up to 50 ft.
- Bar Codes: 2 of 5, UPC/EAN, 128, MIL-STD, AIAG, MSI, Code 39
- Any size label • Flexible format
- Color options • Reversals • Fast
- File input • Menu driven • $279
- Other bar code programs from $49.
- Font Cartridges NOT required
- Fast • Easy • Not Copy Protected!

30 Day Money Back Guarantee!

Bar Code Readers for PC, XT, AT, PS/2

All compatibles plus Kimtron, WYSE-60, Link, and RS-232



- Direct from the manufacturer
- Attaches as 2nd Keyboard
- No software changes needed
- Reads 2 of 5, UPC/EAN, Code 39
- External or Internal on PC, XT, AT

Complete with Steel Wand...... $399

ALSO: Magnetic Stripe, Lasers, and Portables which can be keyboard readers too!

30 Day Money Back Guarantee!

WORTHINGTON DATA SOLUTIONS
417-A Ingalls Street,
Santa Cruz, California 95060
408/458-9938

the OCR function, while other areas are graphics and ought to be either ignored or simply read in as image files. This works, too, but it's pretty tedious to use on a big book that has a different layout for every page.

I'm willing to believe that Spot is the state of the art regarding character scanning of printed text; I've seen nothing better, and I've been looking. However, before I use Spot to read in old paperbacks, I sure wish they'd make some improvements.

The most obvious would be to greatly increase the number of characters you can teach the program. This would let you deal with many more ink-run pairs. It would also slow the program down, of course. Maybe what's needed is an optional increase.

More critical, though, is the need to teach the program some elementary rules about *size*. You should be able to define the period as the minimum-size object the program should pay attention to. Anything smaller just gets ignored. That alone would greatly cut down on the time required to teach Spot a new font. Even more important, though, would be rules about the *maximum* size a letter can have *in each dimension*. No single letter will ever be taller than the distance between two lines. Spot should know this, so that if it ever tries to look at something longer, it will understand that it's looking at two lines.

Third, Spot does know what a line is, but it doesn't automatically look to see whether lines are properly in adjustment. You can do that by defining zones, but I don't think it would be hard to make Spot do that automatically. Then it wouldn't get confused enough to try to take the top part of one line and combine it with the bottom part of the one above it.

Despite all my criticisms, I'm quite impressed with Flagstaff Engineering's Spot. The program won't read my cheap paperback books very well, but it does read them; and they're already working on improvements. I suspect that by the time you read this, I'll have been able to read those old books. Meanwhile, it's near perfect on typescript, and it does fine on most business and financial documents, like the Xerox Annual Report we aimed it at. Given that you understand its limits, I can recommend the program. If you need something like this, you need it bad.

LANtastic

Artisoft offers the state of the art in low-cost PC networks. Other networks are faster and have more features, but none has more bang for the buck. For about $200 a station, you get full networking features and 2-megabit transmission rates over a four-wire cable system. This little wonder is called LANtastic, and despite the terminally cute name, I really like it.

Installing LANtastic is either complicated or a snap, depending on what kind of machine you have. For generic PCs, XTs, and ATs (real or clones), you simply drop in the card, connect the cable, and follow the installation instructions in a remarkably well done manual. Setting up the network with all the options you want can be confusing—and sometimes tedious—but it isn't difficult. Just follow instructions.

As soon as you get away from generic machines or add features to one, installing LANtastic gets tougher. No tougher than installing anything else—we had at least as much difficulty with the CompuPro ARCNET PC system—but tough enough to be discouraging.

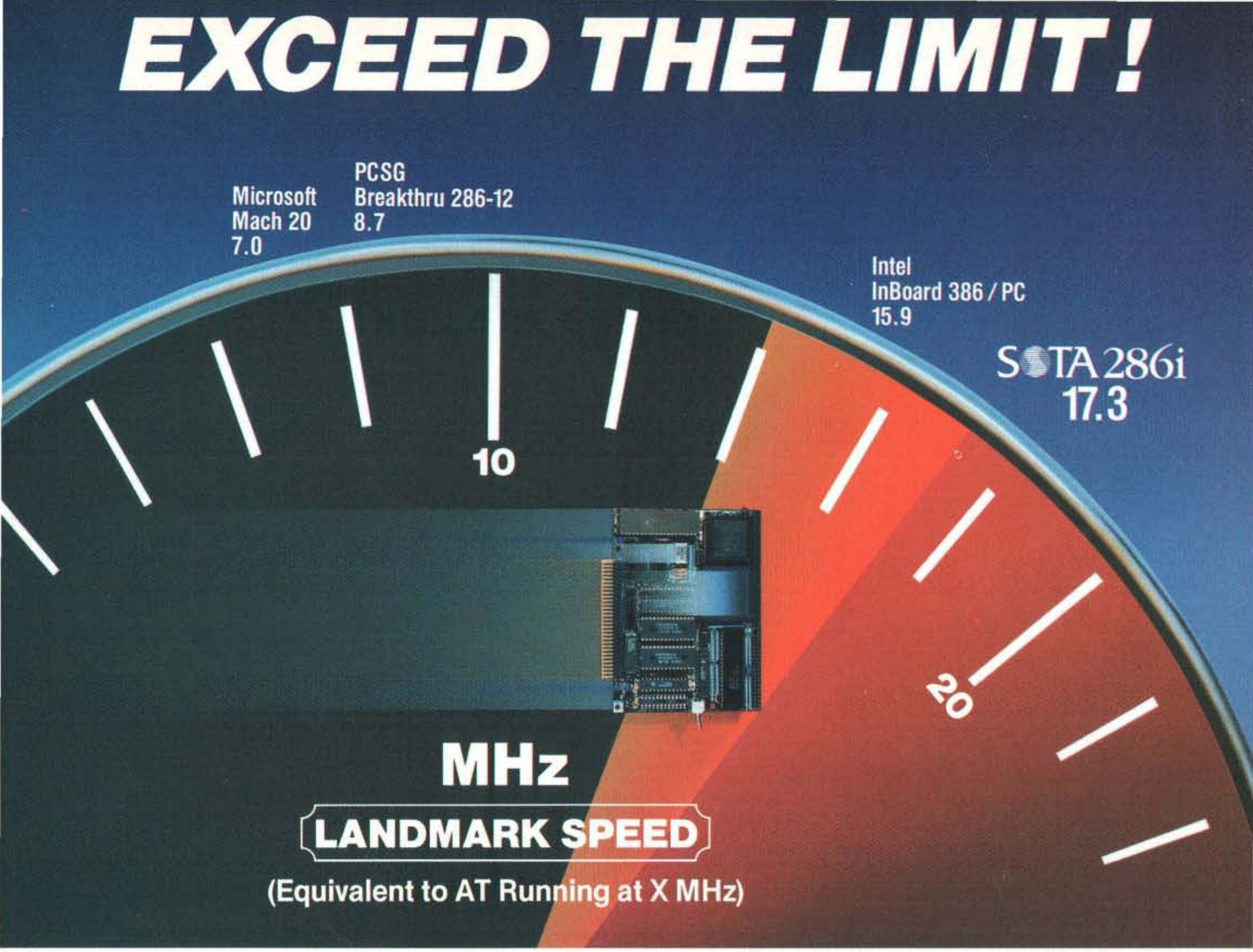
The reason for this is clear enough. Any communications network needs ports to talk through and some means for getting the computer's attention. LANtastic doesn't, but some networks want more, including a direct-memory-access channel.

There are, alas, a limited number of available interrupt requests (IRQs) on your PC. Your XT's hard disk drive needs one. Serial ports need another. Other add-on cards use interrupts. To make it even worse, some brands of AT clones use different IRQs for different purposes.

If that wasn't enough, networks will also need a block of memory. LANtastic doesn't actually need memory, since each LANtastic network card has 32K bytes of memory (and a Z80 processor) on-board; but it does need a place to address that memory. Like the IRQ, you change the LANtastic's memory address by moving little jumpers on the card, and it's explained quite adequately in the manuals. The LANtastic card offers you eight choices of address, all of them in the area above 640K bytes and below 1 megabyte. These areas were reserved in the original IBM PC design for just this sort of purpose. Alas, many of those areas are also in use by other processes.

We have a lot of different computers here at Chaos Manor. Every blankety-blank one of those machines seems to require a different IRQ and memory-address setting on its LANtastic card. For example, the Zenith Z-386 (running at 16 MHz) worked fine with the default

continued



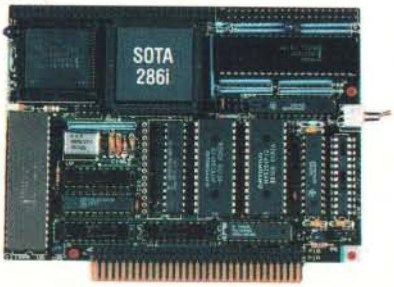
Supports the IBM PS/2 Model 30, PC, XT—Compaq DeskPro, Portable—AT&T 6300—Tandy 1200—Zenith PC's and most 8088 or 8086 machines operating at clock speeds up to 10 MHz.

Fastest

The SOTA 286i is the fastest accelerator you can buy for your PC. Fastest, because it uses the latest VLSI technology to squeeze maximum performance from its on-board processor. Packing 80286 power into your personal computer the SOTA 286i delivers performance rivaling that of a new 386 machine. Twice as fast as an IBM AT, the SOTA 286i performs up to 15.3 times faster than an IBM PC-based on Norton SI.

Most Compatible

In fact, speed is just the beginning. The SOTA 286i is the only turbo board to earn the title ***Universal Accelerator.*** The same board that works in the IBM PC will also work in the Compaq DeskPro, AT&T 6300, PS/2 Model 30 and the list goes on. Not only that, the SOTA 286i is compatible with every add-on board in your system. Networks, video adapters, 3270 emulation boards all function flawlessly. And, the SOTA 286i fully supports the new EMS 4.0 memory standard. No other manufacturer offers this level of compatibility. No one!



OS/2 Upgradeable

Included on the SOTA 286i is a 16-bit expansion connector for attaching such options as the Memory/16i. With its on-board RAM configurable as either EMS 4.0 or extended memory the Memory/16i is ideally suited for those new memory intensive programs. You can even run *AT* specific programs such as ***IBM OS/2*** and Professional ORACLE. A second feature connector is provided for the Floppy I/O Plus. This multimedia disk controller supports both 3½″ and 5¼″ disk drives. It also contains both a parallel and serial port. A complete solution to your computing needs.

Outstanding Engineering

SOTA Technology has been acclaimed as a pioneer in the field of OS/2 compatibility. SOTA's first accelerator, the MotherCard 5.0, was the first and up until now—only product to run IBM OS/2 on a PC. It was nominated for product of the year 1987 in the field of technical excellence. The SOTA 286i is the next generation of accelerators from SOTA Technology. So why buy a product from our competitors that offers half a solution, when you can buy the **fastest,** most **compatible,** most **expandable** accelerator available. ***The complete solution–the SOTA 286i!*** Suggested retail: 12.5 MHz—$595.

SOTA™
STATE OF THE ART TECHNOLOGY
SOTA Technology, Inc.
657 North Pastoria Ave., Sunnyvale, CA 94086
TEL: (408) 245-3366, FAX: (408) 245-0922

SOTA 286i is a trademark of SOTA Technology, Inc. All other products mentioned are trademarks of their respective manufacturers.
SOTA 286i benchmark was run on IBM PS/2 Model 30.

Circle 214 on Reader Service Card

Items Discussed

HiREZ Mouse $149
Logitech
6505 Kaiser Dr.
Fremont, CA 94555
(415) 795-8500
Inquiry 435.

Kyocera F-3010 .... $8395
Kyocera Unison, Inc.
3165 Adeline St.
Berkeley, CA 94703
(415) 848-6680
Inquiry 436.

LANtastic $399
Artisoft, Inc.
3550 North First Ave., Suite 330
Tucson, AZ 85719
(602) 293-6363
Inquiry 437.

ScanJet $1495
Hewlett-Packard
3000 Hanover St.
Palo Alto, CA 94304
(415) 857-1501
Inquiry 438.

Spot $995
Flagstaff Engineering
1120 Kaibab Lane
Flagstaff, AZ 86001
(602) 779-3341
Inquiry 439.

settings of the LANtastic board. The Tandon AT needs quite different settings of both IRQ and memory address. The Cheetah 386 (20 MHz) needs yet another combination. They all work fine once you get the boards set right. The only way to get the right settings, alas, is trial and error.

The Kaypro 386 with its 512K-byte Intel motherboard needs something else again, and indeed I ran out of time before I found a combination that would work right with the Kaypro; it looks like we can't use Quarterdeck's Expanded Memory Manager and LANtastic at the same time, because QEMM fills that area from 640K bytes to 1 megabyte with 32-bit extended memory. I've got the Artisoft people talking to Quarterdeck about this. Note that the network does work with the Kaypro 386; it's just that when you set up the Kaypro to run the network, the Kaypro has only 512K bytes of memory available. Let me repeat that this is a problem peculiar to the *old* Kaypro 386 with the Intel 512K-byte motherboard. They don't make that machine any longer.

Remote WORM and CD-ROM

LANtastic does all the things you expect a network to do. Technically, it's a peer network: you can't do anything to my machine without my permission. Each machine can define which users will be allowed to log on to it and which of its resources it will make available to the other network stations.

The good news is that those resources can include *anything*. Printers, modems, and disk drives, of course; but much more than that.

You can also access WORM (write once, read many) and CD-ROM drives through the network. To the best of my knowledge, LANtastic is the only local-area network that lets you do remote access to a CD-ROM drive.

Better yet, you don't have to install DOS extensions and device drivers on any machines except those that physically have the CD-ROM readers. You can also access multiple CD-ROM systems. For example, we've set up one CD-ROM device on the Z-386 and another on the Cheetah. LANtastic gives each machine access to the other's CD-ROM, while two more machines have access to both. We can be doing word processing—or even communications—on the Cheetah while simultaneously reading data off the Cheetah's CD-ROM onto a generic AT located 50 feet away.

The notion is that I'll set up a generic AT clone as a service machine. It will have modems, a connection to the Kyocera F-3010, a WORM drive, and several CD-ROM readers. All those resources will be available to all the other machines on the network, and the other machines won't even need to have CD-ROM and WORM device drivers installed. I haven't actually done this yet, but I've experimented enough with LANtastic to know it's possible. This is sufficiently intriguing that I would be tempted to do it even if I had only two machines.

Fair warning: remotely accessing CD-ROM drives is slower than accessing them directly. Of course, "slow" is a relative term. If you're using generic XTs running at a Norton System Index of 2 or 3, it won't slow things a bit. It's only when you get to really fast machines like my Z-386 that you notice CD-ROM access takes longer than you expect.

The disadvantages of LANtastic are endemic with any network. As an example, it's a bit disconcerting to be told that I can't do `CHKDSK` on any machine set up as a network server. On the other hand, I don't have to set up my one machine as a *server* at all. If I tell the network that my machine is a *workstation*, I can do anything I ever did; it's only servers that have restrictions on their devices. Workstations can access anything on the network; it's just that their own resources aren't remotely available. Thus, my Cheetah as a workstation can get at the remote CD-ROM and WORM drives, but no one can use my Cheetah. If at another time I want to give remote access to the Cheetah, that takes one DOS command. (To go back from server to workstation requires rebooting, though.)

LANtastic really lives up to its name. Highly recommended.

HiREZ Mouse

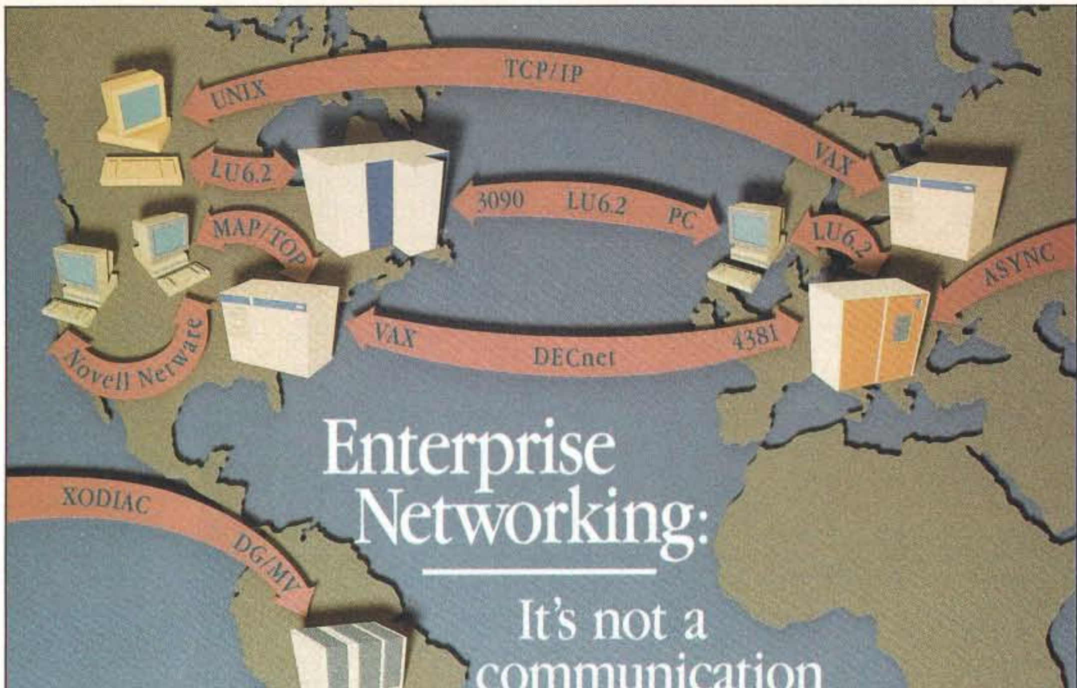
I don't suppose anyone will ever settle the mouse wars: which is best, two buttons or three? Maybe only one?

The two big players in the PC mouse game are Microsoft, with two buttons, and Logitech, with three. The mice are both very good, both widely supported, and each can emulate the other (push both Microsoft buttons at the same time and you get the equivalent of a third button), so at bottom it's just a matter of taking a view.

I've always preferred the Logitech mouse, but I'll be the first to admit it's as much due to background and history as anything else. My first mouse-driven machine was the Lilith, which came out well before Apple's Lisa, much less the Macintosh. The Lilith used an operating system devised by Niklaus Wirth of ETH (the Swiss equivalent of MIT), and it employed a three-button mouse. Indeed, Logitech got its start marketing that mouse both overseas and in the U.S. I've been using Logitech three-button mice ever since.

One reason I'm not tempted to change is the support software Logitech provides with its mouse. Point has always been my favorite editor for quick changes in AUTOEXEC.BAT and CONFIG.SYS

continued



Enterprise Networking:

It's not a communication problem — it's a data management problem.

ORACLE® isn't just the world's best data management system, it's the *only* system that runs on mainframes, minicomputers and PCs — the *only* system that can integrate all your computers and all your data into a single enterprise-wide network.

You've invested a lot of money in communication controllers, satellite links and wire to connect your computers. Yet, to access data located on any computer other than the one to which you are directly connected, you still have to:

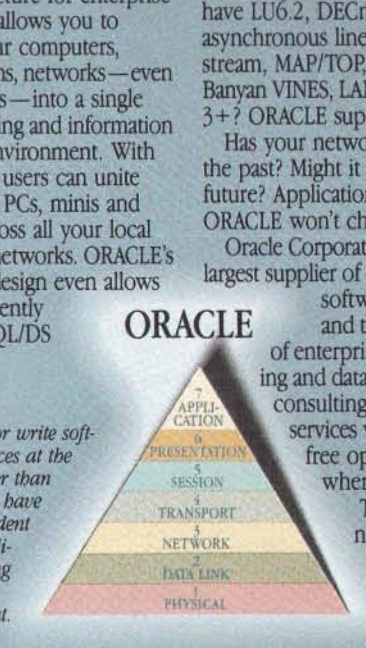
- Know which computer has the data you want
- Know how to use a terminal emulator to log onto that computer
- Know how to use a file transfer program to bring your data over

Enterprise networking must provide easy access to data anywhere in the network. Only ORACLE makes this possible, today. Only ORACLE runs on all your computers, today. Only the ORACLE distributed DBMS provides you with transparent access to data on every computer on the network.

If your users know nothing about communications or networks, ORACLE will help keep it that way.

SQL*Star™ is Oracle's open systems architecture for enterprise networking. It allows you to integrate all your computers, operating systems, networks — even different DBMSs — into a single unified computing and information management environment. With SQL*Star, your users can unite information on PCs, minis and mainframes across all your local and wide-area networks. ORACLE's open systems design even allows you to transparently access IBM's SQL/DS and DB2.

If you purchase or write software that interfaces at the wrong level (lower than OSI Level 7), you have a network-dependent application. Applications built using ORACLE are network independent.



ORACLE solves problems at the right level

Are you unsure which or how many networks your company will ultimately settle on? Do you have LU6.2, DECnet, TCP/IP, asynchronous lines, 3270 data stream, MAP/TOP, Novell Netware, Banyan VINES, LAN Manager, 3COM 3+? ORACLE supports them all.

Has your network changed in the past? Might it change in the future? Applications built using ORACLE won't change a bit.

Oracle Corporation is the world's largest supplier of data management software and services, and the only supplier of enterprise-wide networking and data sharing. Oracle's consulting and support services will insure trouble-free operation anywhere in the world.

To register for the next free ORACLE seminar in your area, call or write today.

ORACLE®

COMPATIBILITY · PORTABILITY · CONNECTABILITY

Call 1-800-345-DBMS, ext. 149 today.

Copyright © 1988 by Oracle Corporation.
ORACLE is a registered trademark and
SQL*Star is a trademark of Oracle Corporation.
The other companies mentioned own
numerous registered trademarks.

20 Davis Drive, Belmont, CA 94002 • World Headquarters (415) 598-8000 • Calgary (403) 265-2622 • Ottawa (613) 238-2381 • Quebec (514) 337-0755 • Toronto (416) 596-7750 • ORACLE Systems Australia 61-2-959-5080 • ORACLE Europe 44-1-948-6911 • ORACLE Systems Hong Kong 852-5-266846

TRBA

U.S. SEMINARS

AL	Birmingham	Oct 11
AR	Little Rock	Oct 13
AZ	Phoenix	Sep 13, Oct 13, Nov 8
	Tucson	Oct 25
CA	Costa Mesa	Sep 1, Oct 4, Nov 11
	Los Angeles	Sep 15, Oct 18, Nov 15
	Oakland	Oct 6
	Sacramento	Sep 22, Nov 10
	San Diego	Sep 8, Oct 6, Nov 3
	San Francisco	Sep 14, Oct 11, Nov 9
	San Jose	Sep 20, Oct 26, Nov 17
CO	Denver	Sep 22, Oct 27
	Colorado Springs	Oct 25
CT	Farmington	Oct 4
	New Haven	Sep 8
	Stamford	Nov 15
DC	Washington *(Federal)*	Sep 16, Oct 21, Nov 18
FL	Ft. Lauderdale	Oct 18
	Jacksonville	Oct 19
	Orlando	Sep 14
GA	Atlanta	Sep 7, Oct 5, Nov 9
HI	Honolulu	Sep 13
IA	Des Moines	Sep 13, Nov 10
ID	Boise	Oct 5
IL	Chicago	Sep 15, Oct 11, Nov 16
	Springfield	Sep 14, Nov 9
IN	Indianapolis	Oct 13, Nov 17
KS	Wichita	Sep 13
KY	Lexington	Sep 14
	Louisville	Oct 12
LA	New Orleans	Oct 28
	Shreveport	Oct 13
MA	Boston	Oct 12
	Burlington	Nov 18
	Springfield	Oct 12
MD	Bethesda *(Commercial)*	Sep 21
	Baltimore	Oct 19
ME	Portland	Oct 5
MI	Detroit	Sep 13, Oct 4, Nov 8
	Grand Rapids	Oct 12
MN	Minneapolis	Sep 27, Oct 19, Nov 10
MO	Kansas City	Sep 14, Oct 18
	St. Louis	Sep 6, Oct 6, Nov 7
NC	Charlotte	Oct 20, Nov 17
	Raleigh	Sep 15, Nov 2
	Winston-Salem	Oct 5
NE	Omaha	Oct 4
NH	Concord	Sep 20
NJ	Iselin	Sep 15, Oct 13, Nov 17
	Princeton	Sep 15, Oct 4, Nov 22
NM	Albuquerque	Sep 29
NV	Las Vegas	Sep 22, Nov 10
NY	Albany	Sep 20, Nov 9
	Buffalo	Oct 4
	Long Island	Sep 20, Oct 19, Nov 16
	New York City	Sep 14, Sep 28, Oct 12, Oct 26, Nov 9, Nov 16
	Rochester	Sep 14, Nov 2
OH	Akron	Sep 20
	Cincinnati	Sep 15
	Cleveland	Oct 19
	Columbus	Sep 22
OK	Oklahoma City	Sep 13
	Tulsa	Oct 25
OR	Portland	Sep 8, Nov 15
PA	Harrisburg	Sep 26
	Philadelphia	Sep 19, Oct 26, Nov 18
	Pittsburgh	Oct 26
	Valley Forge	Sep 8, Nov 10
RI	Providence	Sep 22
SC	Charleston	Oct 5
	Columbia	Nov 16
	Greenville	Oct 19
TN	Memphis	Sep 14
	Nashville	Nov 9
TX	Amarillo	Sep 20
	Austin	Oct 20
	Dallas	Sep 7, Oct 4, Nov 2
	Ft. Worth	Nov 9
	Houston	Sep 8, Oct 6, Nov 10
	Midland	Oct 19
	San Antonio	Oct 21
UT	Salt Lake City	Sep 20, Nov 9
VA	Norfolk *(Federal)*	Oct 4
	Richmond	Oct 6, Nov 1
VT	Burlington	Sep 28
WA	Seattle	Sep 14, Oct 20
	Spokane	Nov 3
WI	Madison	Oct 5
	Milwaukee	Oct 12, Nov 29

CANADIAN SEMINARS

To register for Canadian seminars, please call the office nearest you: ***Calgary*** **403-265-2622,** ***Ottawa*** **613-238-2381,** ***Quebec*** **514-337-0755,** ***Toronto*** **416-596-7750.**

Calgary	Sep 15, Nov 17
Edmonton	Oct 6
Halifax	Oct 13
Kingston	Sep 16
London	Oct 20
Montreal	Sep 28, Oct 26, Nov 23
Ottawa	Sep 1, Oct 6, Nov 3
Quebec	Sep 7, Oct 5, Nov 2
Regina	Sep 22
Saskatoon	Nov 10
Toronto	Sep 13, Oct 11, Nov 8
Vancouver	Sep 8, Nov 10
Victoria	Nov 24
Winnipeg	Oct 20

Attn: National Seminar Coordinator
Oracle Corporation • 20 Davis Drive
Belmont, California 94002

☐ My business card or letterhead is attached. Please enroll me in the *FREE* ORACLE seminar to be held

at: ____________________

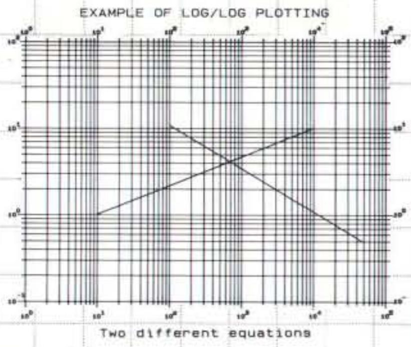
on: ____________________

BYTE

TECH*GRAPH*PAD

Still trying to get Engineering & Scientific graphs from a Business program?

TECH* GRAPH* PAD



Easy-to-use technical graphing & plotting software for engineers & scientists. Compatible with Lotus 1-2-3 worksheets, other spreadsheets, PRN & ASCII files, & most data acquisition packages.

Now shipping Version 3.0!

- X-Y, Semi-log, Log/Log, Polar Plots
- Curve Fitting • Data Smoothing
- Labels, Scale, & Color Control
- Multiple X-Y Axes
- Error Bars • Greek Letters
- Laser Printer, Plotter, Printer Output
- IBM PC/XT/AT, PS/2, Apollo, DEC compatible

CALL

(617) 890-1812

Dealer Inquiries Invited

binary engineering

100 Fifth Ave., Waltham, MA 02154

files, breaking big ASCII files up into smaller ones, and even as a substitute for the DOS `TYPE` command. Point is fast, intuitive to use, and configurable. The newest version of Point can, in an emergency, even be used without a mouse, although I sure wouldn't want to do that very often; but since one of the first things I always do when I set up a new machine is install a mouse on it, that doesn't present a problem.

Logitech also provides support with its Logimenu and Click packages. These are memory-resident programs that can glue in mouse support, complete with pull-down menus, for any application that doesn't have it. As an example, I used the Logitech software to add mouse support to Borland's new Sprint editor, as well as to my old standby, Q&A Write. My mouse implementations aren't very clever because I haven't had much time to develop them; but you can set up your mouse to do almost anything.

Logitech's latest mouse is the HiREZ. This is a bus mouse only, meaning that it takes up a slot but doesn't use up a port. The advantage is that it can be used on a tiny desk since it works at 320 dots per inch (compared to 200 dpi for the usual mouse). The result is that you can control operations on high resolution (EGA and VGA displays) much more easily. We installed the HiREZ on the Z-386, and it really is easier to use—more precision with less motion—than the mouse it replaced.

My only complaint about the HiREZ is that they haven't (so far as I know) combined the HiREZ mouse with an EGA or VGA video board; the Logitech EGA&Mouse board works fine (we have one in the Zenith Z-248 80286 system), but that supports only the standard 200-dpi Logitech mouse. I make no doubt they'll have a VGA/HiREZ board soon.

Logitech is one of those companies that's always going right out to the edge of the state of the art. I have yet to see a Logitech product that I don't like.

Kyocera F-3010 Compact Laser Printer

Let me confess straight off that I've got no business with a printer as good as this one. Having said that, let me add that they'll get it back over my bruised and broken body. This printer is *wonderful*. If there's a better 300-dpi printer available, I don't know about it.

The Kyocera F-3010 is built around the Kyocera engine; a similar but slower engine is used in a Mannesmann Tally printer. The F-3010 has all the features of that engine, including two output bins (face-down and curled, and face-up and flat), two input bins (put letterhead in one and plain paper in the other), plus a manual feed capability. Unlike the Mannesmann Tally printer, the F-3010 does *not* have cartridge slots. That's because it doesn't need them. Instead, it has two IC card slots. The cards can control the F-3010's programming language. There are three resident fonts, and the printer also has enough memory to hold 48 downloadable fonts.

There's more. The Prescribe printer-control language is built in. Prescribe lets you do almost anything you'd like, including draw complicated pictures. You can do about anything in the programming language that you can do from the keyboard. Prescribe commands are fed to the F-3010 as ASCII strings; you can do that from BASIC or simply send them out the printer port from your console.

Prescribe can also be used as a built-in font editor, with a font-generation capability. You can change the point size or rotate the resident fonts. If you don't like the fonts you have, you can play games with them.

I confess I'm still learning about this printer. It isn't that the machine is hard to use. It just has so many features that I haven't learned them all.

The control panel is extraordinarily complete. Instead of little message numbers, the F-3010 has a liquid crystal display that tells you things. It will, for instance, tell you which printer it is emulating: there's a wide choice, including Hewlett-Packard's LaserJet Series II, the IBM PC Graphics Printer, the Epson FX-80, and even the old standby, the Diablo 630. You can switch emulations in software or from the control panel. You can also use the control panel to make the F-3010 print out a list, with samples, of all the fonts it's currently aware of. That's three resident fonts when you first turn it on; you can add more by downloading them off disks.

The optional font disk that came with the F-3010 was Microsoft's Z font package. These fonts are the same as those in the cartridge that permanently resides on my Hewlett-Packard LaserJet Plus, so it seemed a good thing to use for a test of the F-3010.

I connected the F-3010 to the serial output port of the Printer Optimizer; this is where the LaserJet Plus is usually connected. The F-3010 has both serial and parallel input ports; the parallel port is of the Centronics variety.

Downloading the Z fonts took about 2 minutes. Once that was done, I went into

continued

Great Performers, Superb Performance

The QIC Research 80286 and 80386 machines.

These represent the latest in PC speed and compatibility for your Desktop Personal Computer. Made in the USA, burned in for 48 hours and available with NCS on site service contract, the QIC systems boast tenacious reliability. And the systems expandable memory, DOS and OS/2 capabilities will allow your business to run virtually any word-processing, spreadsheet, graphic or networking package available. From the reliable 80286/8MHz system to the very fast 80386/20MHz, QIC Research can provide the solution to all your business computing needs.

MODEL	CPU	WAIT STATE	SLOTS 16-bit	SLOTS 8-bit	SLOTS 32-bit	STANDARD MEMORY	MAX ON BOARD	POWER SUPPLY	VGA	EGA	MONO
QIC 386-20	386-20	0	5	2	1	1MB	16MB	200W	$3,670	$3,420	$3,050
QIC 386-16	386-16	0	6	2	0	1MB	1MB	192W	$2,899	$2,515	$2,145
QIC 286-12	286-12	0	4	4	0	1MB	1MB	192W	$2,299	$1,895	$1,525
QIC 286-10	286-10	0	6	2	0	512K	1MB	192W	$2,099	$1,760	$1,390
QIC 286-10	286-10	1	6	2	0	512K	1MB	192W	$1,995	$1,609	$1,239
QIC 286-8	286-8	1	6	2	0	512K	1MB	192W	$1,795	$1,365	$999

*All Systems come with 1.2MB HardDisk/Floppy Controller, 101 key enhanced keyboard and complete documentation.

To Order a QIC computer,

(SALES) .... (408) 432-8880
(Technical Support) .... (408) 432-7520
(FAX Number) .... (408) 432-1250
All prices and models are subject to change without notice.

QIC
RESEARCH INC.

Circle 178 on Reader Service Card

1961 Concourse Drive Suite C
North San Jose, California 95131
QIC is not affiliated with MDS Quanel, Inc.

QIC-09B 08/29/88

Q&A Write and told it to print on a LaserJet Series II, and I fed my last column to the F-3010.

It printed blazingly fast, 18 pages a minute (as advertised), but the top and bottom margins were wrong. I couldn't figure this out. That file had printed perfectly on the LaserJet Plus. After stewing for a while, I went back in and told Q&A Write that it was going to print on a LaserJet Plus, not a II, and tried again. Voilà! Then I tried another word processing program instructed to print to a LaserJet Series II, and that worked. It turns out that I was using an older version of Q&A Write that didn't properly know about interfacing with a LaserJet Series II.

The F-3010 is a heavy-duty printer, designed to be used a lot more than I ever will need it. I'm still learning about it, but by me it's state of the art for a 300-dpi printer. If you need that kind of capability, you ought to look at this one. I'll definitely have more to say about it in future columns.

Winding Down

I'm about out of space, and there's still a lot to cover. I guess the bottom line is that the state of the art in PCs changes rapidly; what used to be the outer edge of the envelope becomes the "standard" for serious users, and the old "standard" systems drop behind or die.

For me, "serious user" state of the art is an 80386 at 16 MHz or more; at least 4 megabytes of 32-bit memory; at least 80 megabytes of hard disk space, but better would be Priam's 330-megabyte hard disk drive; a good WORM drive for backup; and a 9600-bit-per-second modem (we routinely run at 2400 bps over Tymnet).

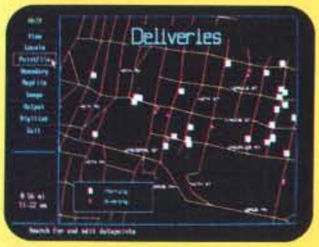
EGA remains the business graphics standard, but VGA is catching up fast. The Zenith Flat Technology Monitor (which runs nicely off a good VGA card like Video Seven's VEGA) is far and away the most impressive standard-size monitor available. Keyboards have improved greatly; both Northgate (which puts the function keys on the left side, as they were on the older PCs) and DataDesk make wonderful add-on keyboards that are in general much better than the ones you get with your machine, and they don't even cost much.

CD-ROM systems are coming along also. Microsoft has a number of new CD-ROM products coming out, including a Programmer's Library that puts everything you ever needed to know about C, Windows, and OS/2 onto one CD-ROM disk. This year, we'll see CD-ROM drives that run off small-computer-system-interface ports; since Priam already makes a SCSI 330-megabyte hard disk drive, and it will be no great trick to make a WORM drive interface through SCSI, by this time next year that will be state of the art as well.

I love the way they keep expanding the envelope. It's like I have all those bright people working to keep me happy. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

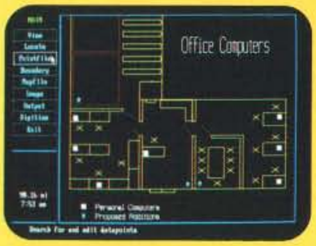
With *MapInfo,* More Ways Than Ever To Map Your Data



Pin Map. Automatically use your existing database (from dBASE III or others) with street maps that we can supply. Maps from over 300 U.S. cities and towns contain all addresses, accurate to the correct block and side of the ship street. Type any address and MapInfo will find it for you. Call to the screen your complete record.

Thematic. Use our boundaries (state or county) or draw your own (sales regions, election districts, etc.). Create a database for the region (population, average income, etc.) Color code boundaries or entire regions based on parameters you define.

Presentation. Use powerful graphics commands to add your own titles, legends and text. Create arrows, windows or callouts. Turn on or off labels of points, streets, bridges, regions, etc.



Visual Database. Draw anything from a floor plan to aircraft design. Store data on any point or region. Create multiple layers to add flexibility to your display.

And that's just a sample. If you need to map your data, MapInfo can do it for as little as $750. IBM PC or 100% compatibles, with 640K memory, a hard disk drive, and graphics capability.

To order, call 1-800-FASTMAP. In New York State, call 1-518-274-8673 (Telex 371-5584).
MapInfo Corp., 200 Broadway, Troy, NY 12180

MapInfo

dBASE III is a trademark of Ashton-Tate. IBM and IBM PC are trademarks of International Business Machines Corp.

Circle 133 on Reader Service Card

Integrated Software for Schematics & PCB Artwork

Introducing HiWIRE®-Plus

Wintek's smARTWORK® pioneered low-cost printed-circuit-board CAD. Then HiWIRE set the standard for productivity and ease-of-use in schematic capture. Now Wintek introduces HiWIRE-Plus, integrating HiWIRE's schematic features with a powerful printed-circuit-design facility.

Creating Schematics

With HiWIRE-Plus, simply connect library symbols with wires and buses. Creating and changing symbols is fast and painless. Produce your drawing using a dot-matrix printer, laser printer, or pen plotter.

Circuit-Board Design

HiWIRE-Plus gives you all the design freedom you want: you choose the grid size, trace widths, and pad shapes. The board size and number of layers are virtually unlimited. HiWIRE-Plus is perfect for surface-mount, microstrip, and ECL applications.

CURRENT VERSIONS
HiWIRE, V1.1r4; smARTWORK, V1.4r1

HiWIRE-Plus Advantages

- ☐ One tool for schematics and printed-circuit artwork
- ☐ Easy-to-learn menu-driven operation; complete documentation and tutorial
- ☐ Schematic libraries with TTL, CMOS, ECL, ladder, microprocessor, and discrete components
- ☐ Netlist and bill-of-materials utilities included
- ☐ Circuit boards up to 60x60 inches and 256 layers
- ☐ Variable grid size, trace width, and pad size (.001″ resolution)
- ☐ PCB library with DIPs, SIPs, SMDs, PGAs, TOs, and edge and D connectors
- ☐ Schematic-to-layout cross-checking
- ☐ Design-rule checker
- ☐ 800 number for free support

WINTEK®

"HiWIRE", "smARTWORK", "Wintek", and the Wintek logo are registered trademarks of Wintek Corporation.

System Requirements

- ☐ IBM PC, XT, AT, or PS/2 with 512K RAM, printer port, color monitor, and CGA, EGA, or VGA graphics card
- ☐ Microsoft Mouse
- ☐ IBM ProPrinter or Epson dot-matrix printer, and/or
- ☐ Houston Instrument or Hewlett-Packard pen plotter

Higher Performance Better Value

Still only $895, HiWIRE-Plus delivers quality schematics and PCB artwork. You don't need to guess if HiWIRE-Plus is right for you—*we guarantee it!* Try it for 30 days at absolutely no risk. Call toll free today and put HiWIRE-Plus to work for you.

Wintek Corporation
1801 South Street
Lafayette, Indiana 47904-2993
(800) 742-6809 or
(317) 742-8428
FAX: (317) 448-4823
Telex: 70-9079

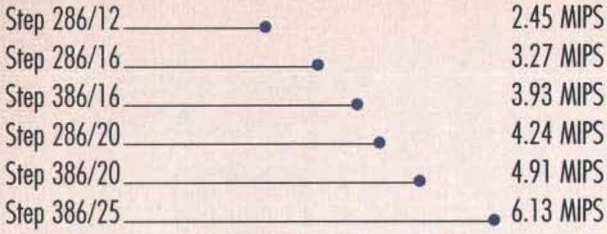
Europe: RIVA Ltd., England,
Phone: 0420 22666, FAX: 0420 23700
Australia: Entertainment Audio Pty, Ltd.,
Phone: (08) 363-0454

Circle 231 on Reader Service Card

See the Everex Step computers at Com
Las Vegas Hilton Center
Booth #H8206-H8406

EVEREX

Everex and Step are trademarks of Everex Systems, Inc. 386 is a trademark of Intel Corp.



Step 286/12	2.45 MIPS
Step 286/16	3.27 MIPS
Step 386/16	3.93 MIPS
Step 286/20	4.24 MIPS
Step 386/20	4.91 MIPS
Step 386/25	6.13 MIPS

Source: Power Meter MIPS Version 1.3. The Database Group, Inc.

"I used to be afraid of monsters. Now I can't get along without them."

Janet Johnson, President
Coordinated Digital Systems
Dayton, Ohio

"I'll be right over."

The most incredible collection of people find their way to my door. Students. Aerospace engineers. Genealogists.

They come because they hear we do more than sell computers out of a box. We try to make everything very personal.

We know our products backwards and forwards because we use them ourselves. We write custom software.

We're writing a lot of business.

We work almost exclusively with one computer company. Everex.

Because every one of their six computers is at the head of its class.

And because they take care of me the way I like to take care of my customers.

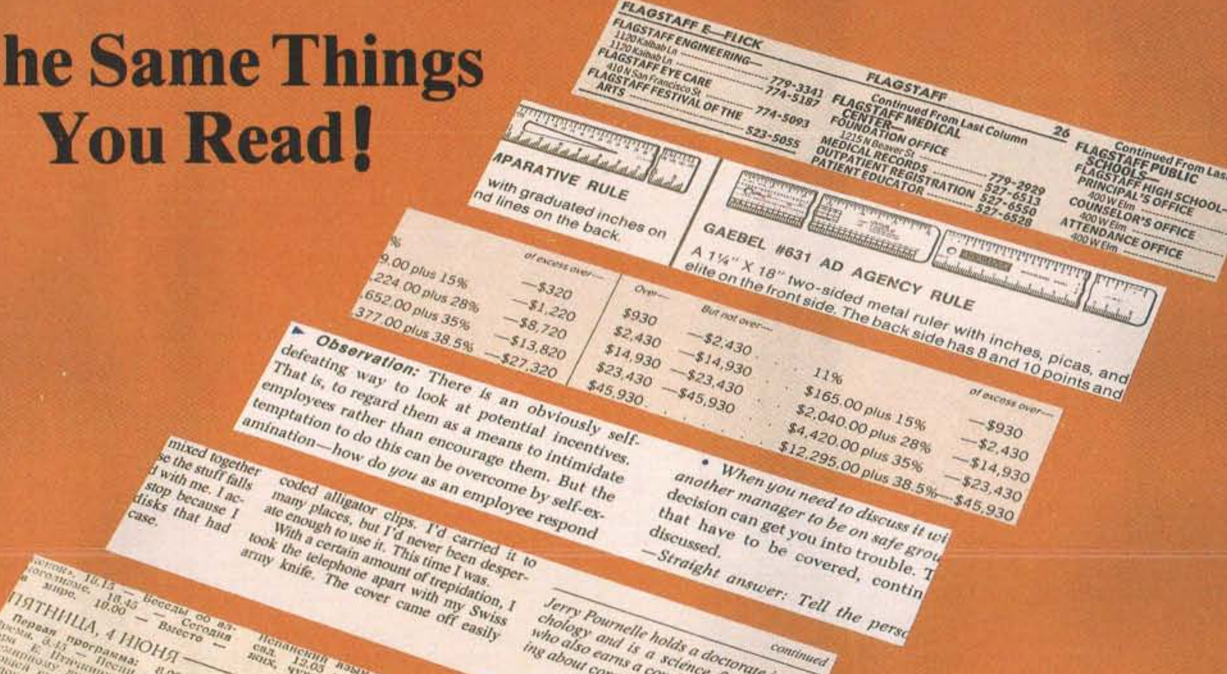
Find out more about Everex Step computers. Call 1-800-356-4283. Everex Computer Systems Division, 48431 Milmont Drive, Fremont, CA 94538.

Circle 85 on Reader Service Card (DEALERS: 86)

EVEREX
STEP

Train Your PC to Read...

...the Same Things You Read!



FLAGSTAFF E—FLICK
FLAGSTAFF ENGINEERING—
1120 Kaibab Ln 779-3341
FLAGSTAFF EYE CARE
410 N San Francisco St 774-5187
FLAGSTAFF FESTIVAL OF THE 774-5093
ARTS 523-5055

FLAGSTAFF
Continued From Last Column 26
FLAGSTAFF MEDICAL CENTER—
FOUNDATION OFFICE
1215 N Beaver St
MEDICAL RECORDS 779-2929
OUTPATIENT REGISTRATION 527-6513
PATIENT EDUCATOR 527-6550
527-6528

Continued From Last Col
FLAGSTAFF PUBLIC SCHOOLS—
FLAGSTAFF HIGH SCHOOL—
PRINCIPAL'S OFFICE
400 W Elm
COUNSELOR'S OFFICE
400 W Elm
ATTENDANCE OFFICE
400 W Elm

APARATIVE RULE
with graduated inches on
nd lines on the back.

GAEBEL #631 AD AGENCY RULE
A 1¼" X 18" two-sided metal ruler with inches, picas, and elite on the front side. The back side has 8 and 10 points and

%	of excess over—
9.00 plus 15%	—$320
224.00 plus 28%	—$1,220
652.00 plus 35%	—$8,720
377.00 plus 38.5%	—$13,820
	—$27,320

Over—	But not over—	11%	of excess over—
$930	—$2,430	$165.00 plus 15%	—$930
$2,430	—$14,930	$2,040.00 plus 28%	—$2,430
$14,930	—$23,430	$4,420.00 plus 35%	—$14,930
$23,430	—$45,930	$12,295.00 plus 38.5%	—$23,430
$45,930			—$45,930

Observation: There is an obviously self-defeating way to look at potential incentives. That is, to regard them as a means to intimidate employees rather than encourage them. But the temptation to do this can be overcome by self-examination—how do you as an employee respond

• *When you need to discuss it wi another manager to be on safe grou decision can get you into trouble. T that have to be covered, contin discussed.*
—Straight answer: Tell the pers

mixed together e the stuff falls l with me. I ac- stop because I disks that had case.

coded alligator clips. I'd carried it to many places, but I'd never been desperate enough to use it. This time I was.
With a certain amount of trepidation, I took the telephone apart with my Swiss army knife. The cover came off easily

continued

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future.

MAY 1987 • BYTE 261

Flagstaff Engineering's optical character recognition software reads almost any printed or typewritten text.

SPOT,* our trainable OCR program, allows you to compile information from books, magazines, typewritten records, genealogical data, directories, catalogs, and public documents, including foreign-language material. The data captured by **SPOT** can be used by database, word processing, desktop publishing and typesetting applications.

SPOT's flexible output options allow you to preserve the original page format, including columns and margins. Reformatting options include the choice of DCA or ASCII output files, with options to generate single-column output from multiple-column text.

Features:

- High recognition accuracy
- Fast, easy training
- Up to five fonts per page
- Handles ligatures and kerned type
- Foreign language character sets
- Spelling and context checking
- On-line correction
- Affordable at **$995.00**

Flagstaff Engineering leads the PC industry in desktop conversion systems for 9-track tape and 8-inch diskette data files. We have already supplied thousands of customers worldwide with our OCR systems. Call for the best prices on Panasonic, Hewlett-Packard, and Canon scanners. Dealer and volume discounts are available.

Flagstaff Engineering can modify the software code to meet your custom applications. For details, call us at (602)779-3341.

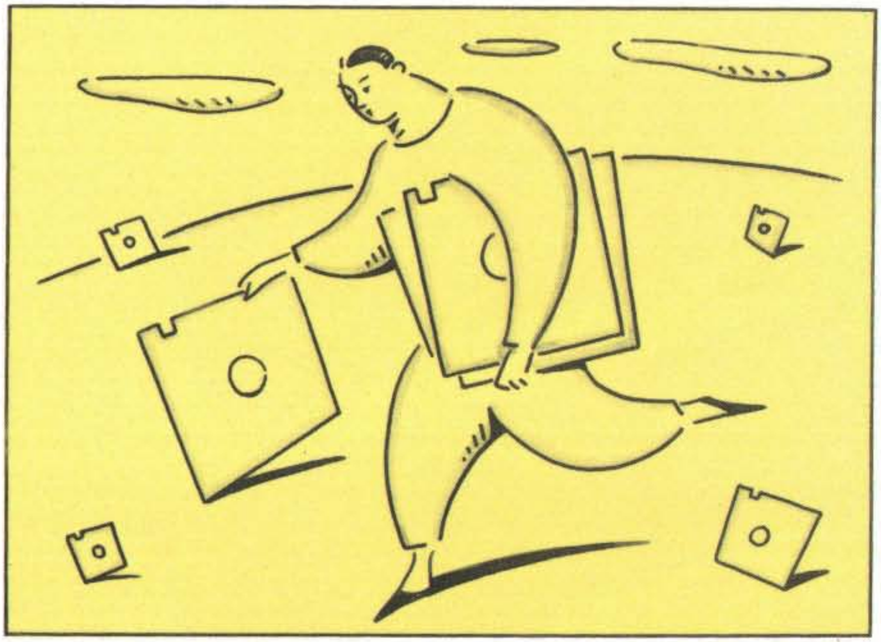
***Syntactic Pattern Optical Translator*

FLAGSTAFF
ENGINEERING

Come see us at COMDEX Booth #C107
1120 Kaibab Lane • Flagstaff, AZ 86001
(602)779-3341 • Telex 705609 • FAX (602)779-5998
Circle 236 on Reader Service Card (DEALERS: 237)

MAPPING THE SOFTWARE WORLD

In a world of great software, what you need is what you use



When I recently lost the contents of my hard disk during a long-distance move, I reacted with an emotion that surprised me. Rather than feeling panic and despair, I felt euphoria and freedom. All the stuff I'd been keeping on the disk but never using was gone! I could start over with a clean slate.

I knew I'd have to salvage my documents, utility programs, and a couple of essential applications from the backup floppies, but I'd been forced to do some long-overdue housecleaning. I imagine my delight in this situation is similar to what people feel when an airline reimburses them for lost luggage: You miss the old clothing, but hey—it's time to go shopping for a new wardrobe.

I'm slowly filling the hard disk with new software. Old friends—programs I've used for years—are being left quietly on the shelf. I'm going for new programs, new habits, and new ways of doing things. I'm not willing to admit that I was stuck in a rut, but running my Tandon IBM PC AT clone is suddenly more invigorating than it was before the disk got trashed. I realize that this is going to be a long undertaking, and it's nowhere near complete.

One side benefit of this has been a thorough reexamination of applications software from the point of view of a user, rather than from that of a columnist. When you write about software for a living, you begin to classify those programs you don't despise into three categories: programs you use, programs you like, and programs you'd recommend.

Though the boundaries between these groups are often blurry and there's quite a bit of overlap, the distinctions are real. When your bookshelves are filled with every package imaginable (and some that are beyond imagining), you must develop some sort of mental algorithm for assessing programs outside the traditional constraints of cost and availability, which are not germane because you get the stuff free, whether you want it or not.

What I use is dictated mostly by habit and convenience rather than by any intelligent scheme of analysis. As an example, I use WordStar because I've used it for a long time and its commands are second nature to me, not because it's the best word processor, or even the best word processor for my needs. Right now, I'm trying to tailor my personal software choices more closely to what I do. When I'm done, I'll be much more efficient and (I hope) happier.

How does this differ from what I like? Well, there are tons of programs I like that I don't use. I mean, there are quite a few good database managers on the market, but I don't need to use five at a time. I'm bound by the same limitations as anybody else; I don't have room in my head for more than a few programs' command sets. And some programs that I love, I just don't use on a day-to-day basis, like VP-Expert from Paperback Software; my work doesn't really require that I develop expert systems.

What's right for a novice user in a business environment is not necessarily right for a sophisticated software hacker who's writing a technical encyclopedia. I usually recommend programs that I use and like, but I recognize that there is no universal collection of programs that can be deemed "the best." The MS-DOS universe is such a smorgasbord of top-quality products that even people in the same line of work can choose different packages based on personal whim with no worry of losing functionality.

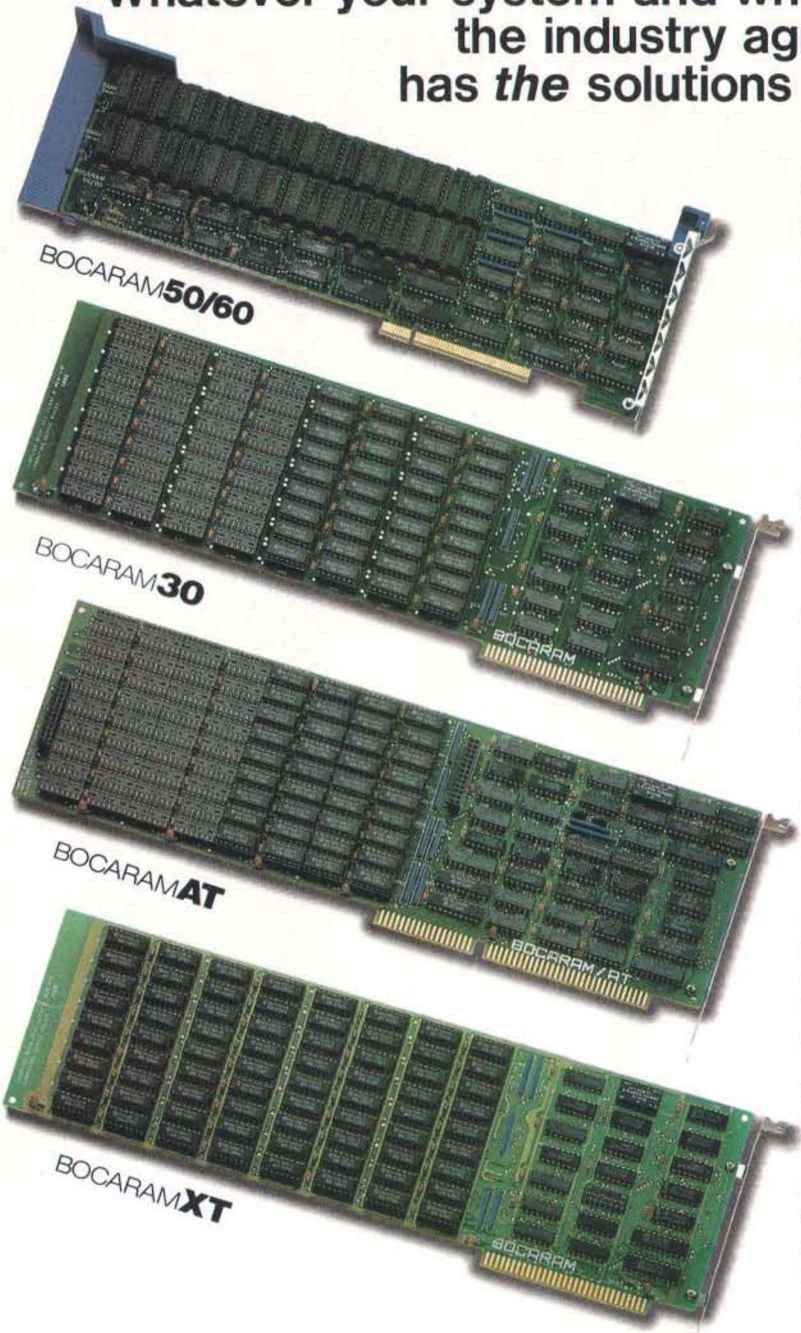
I'm developing a new map of the software world. I thought I'd pass on what

continued

ILLUSTRATION: CATHARINE BENNETT © 1988

Solutions.

Whatever your system and whatever your requirement, the industry agrees that Boca Research has *the* solutions for every memory need.



BOCARAM 50/60 – *"For the price-conscious, we suggest the Boca Research Bocaram 50/60 ...an excellent value."*
– INFOWORLD

- Expandable to 4MB per board
- Supports DOS, OS/2, and EMS applications
- Designed for IBM Micro Channel Architecture
- Utilizes 1MB 120NS DIPs
- Order No. BR5000 $295. (0K)

BOCARAM/30 – *"...our recommendation for the PS/2 memory solution."*
– Charlotte Woodland, Sales Manager
Micro Central, Inc. (Distributor)

- Expandable to 2MB per board
- Supports Lotus/Intel/Microsoft EMS
- Designed for IBM PS/2 Models 25/30
- RAMdisk and print spooler utilities
- Order No. BR3000 $175. (0K)

BOCARAM/AT – *"The 'Swiss Army Knife' memory board...it's incredible."*
– Joseph Katz, Contributing Editor
REMark/Mainstream Computing

- Expandable to 4MB per board
- Supports DOS, OS/2, and EMS applications
- Operates with 16-bit CPUs up to 24MHz
- RAMdisk and print spooler utilities
- Order No. BRAT00 $225. (0K)

BOCARAM/XT – *"Best value among XT boards for budget-minded users."*
– INFOWORLD

- Expandable to 2MB per board
- Supports Lotus/Intel/Microsoft EMS
- Operates with CPUs up to 12MHz
- RAMdisk and print spooler utilities
- Order No. BRXT00 $175. (0K)

At Boca Research, we're committed to memory. For more information on these and other Boca Research solutions, see your dealer or contact us directly.

BOCARAM 50/60, BOCARAM/30, BOCARAM/AT and BOCARAM/XT are trademarks of Boca Research, Inc. All other references to computer systems, software and peripherals use trademarks owned by their respective manufacturers.

©Copyright 1988 Boca Research, Inc.

BOCA
RESEARCH INC

6401 Congress Avenue, Boca Raton, FL 33487 ■ Phone: (407) 997-6227 ■ TELEX: 990135
FAX: (407) 997-0918

Circle 30 on Reader Service Card

I'm discovering about the geography. Bear in mind that I'm only one explorer; I haven't visited every city and town on every continent.

Integrated Software

The rule for integrated software used to be that you couldn't compare it to stand-alone products. Integrated packages always seemed to lack critical features. That's not true today. The state of the art has advanced to the point where you can do quite well with most of the combination products on the market.

I'd recommend integrated software to almost anyone now, with this caveat: Be prepared to buy a stand-alone product for your primary application area and use the integrated package for everything else. You may not have to do this, but it's more likely that you'll need the truly obscure features in your area of concentration. If your primary application lies outside the big four (i.e., word processing, spreadsheet, database, and telecommunications), don't worry about missing out on power features; you'll get enough of them to keep you humming along.

One of the first things I put on my clean hard disk was Microsoft Works, in place of Framework II. I'm developing an increasing affection for the product, largely due to my fondness for Works on the Macintosh. Like its Mac cousin, Works on the PC can handle 80 percent to 90 percent of what any mortal needs to do on a computer. The program is intelligently if simply designed. It's not the fastest around, but it's no slug. The word processor module is nearly as powerful as Microsoft Word's, but it's friendlier and easier to master. Good spelling checking. The spreadsheet and database sections are adequate for all but the heaviest use.

I have not reinstalled Framework II because I'm awaiting delivery of Framework III (any day now). I have always liked Framework II, but I found myself avoiding it as time went on, largely because I found myself forgetting how to do things. And its built-in programming language, FRED, is incredibly tough. But this is one slick product, and I hear Framework III has considerably improved database and spreadsheet modules. I'll see how I feel about this program after I get the new version.

So I'm using Works, I like Framework II, but do I recommend them? Nope; I'm more prone to tell people to check out the Smart Series from Informix Software. The individual application modules can run just fine as stand-alone programs, and the integrating shell is better for quickly developing multifunctional applications for users than anything else out there. Also, the development/macro language is as readable as BASIC, and the Smart Series will follow your actions and generate code automatically. This was one of the first microcomputer packages to be rewritten for network use, and it's rock solid.

Word Processing

There are so many fine programs, it's tough to choose. I've substituted Professional Write 2.0 from Software Publishing, the descendant of PFS:Write, for my old standby WordStar. It's speedy, reliable, and absolutely effortless to use. You won't need a manual for this one, unless you plan to do something extremely arcane, but it doesn't skimp on features. My favorite aspect of the program is its ability to read and write files in most major formats. Conversion is painless and invisible. I also recommend

continued

PrintQ®

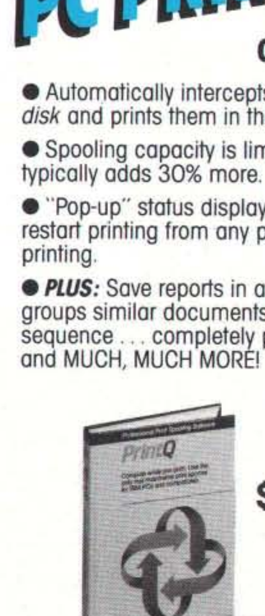
"CHEAPER THAN HARDWARE SOLUTIONS AND FAR MORE CAPABLE THAN OTHER PRINT SPOOLING PROGRAMS"

— PC World, February 1988

POWERFUL PC PRINT SPOOLING

Actually lets you compute while you print AND...

- Automatically intercepts documents bound for the printer, spools them to *disk* and prints them in the background.
- Spooling capacity is limited only by *disk* space and *PrintQ* compression typically adds 30% more.
- "Pop-up" status display allows you to control each PrintFile individually; restart printing from any page; view any document on screen with/without printing.
- ***PLUS:*** Save reports in a DOS file ... archive reports for reprinting ... groups similar documents – minimizes form changes ... prioritize print sequence ... completely programmable ... simplifies forms alignment ... and MUCH, MUCH MORE!



only $89^{00}

Easy To Use! Installs In Seconds!

PrintQ is 100% software – just insert disk, type INSTALL, and go! For IBM PC/XT/AT, PS/2 and all compatibles. Works with *any* printer or plotter, uses 46K RAM, not copy protected, and is *fully guaranteed.*

Order Now by calling toll-free:
(800) 346-7638
In New Jersey: (201) 584-8466
Or see your local dealer.

SDI
Software Directions, Inc.
1572 Sussex Tpke.
Randolph, NJ 07869

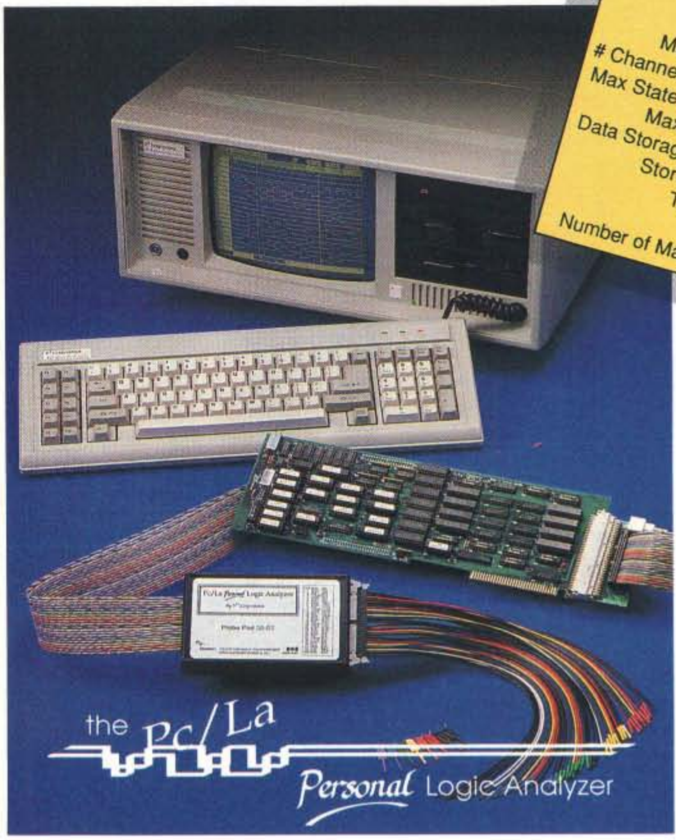
BTI88

Circle 208 on Reader Service Card

OUR MOVE

	Pc/La	HP1651A *	Phillips 3633 *	Tektronix 1220 *
Total Channels	**32**	32	32	32
Max Timing Rate	**100 Mhz**	100 Mhz	100 Mhz	100 Mhz
# Channels @ Max Rate	**16**	16	8	8
Max State change Rate	**25 Mhz**	16.6 Mhz	12.5 Mhz	10.0 Mhz
Max State Clock	**50**	25	25	25
Data Storage (per chan)	**4K**	1K	1K	2K
Storage Method	**Linear**	Transitional	Linear	Linear
Trig Method	**Multi-Way Branch & Loop**	Linear Sequential	Linear Sequential	Linear Sequential
Number of Match Regs	**28**	8	8	8

* Based on published specifications



In the mid to late 70's, when engineers designed with SSI and MSI, the demands that they made on logic analyzers reflected the technology that they worked with - low density, low complexity, and low performance.

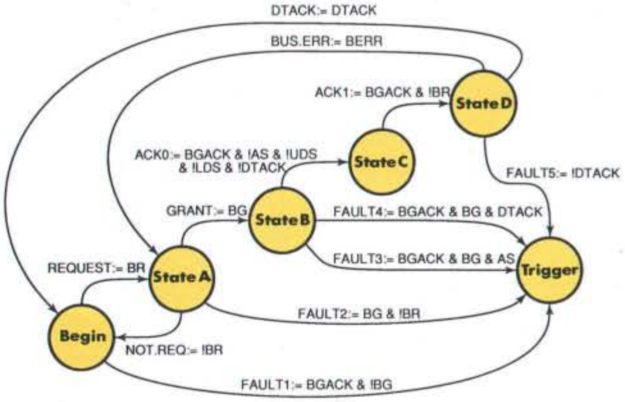
Along came the 80's and with it PALs, GALs, PLAs, LCAs, ASICs, faster CISCs, and RISC machines. Technology leaped ahead... same old logic analyzers.

Finally, a machine tuned to the times. The Pc/La provides you with competitive sample speed and channel count, but more importantly, its superior trigger capabilities enable you to track down system bugs quickly and efficiently. No fumbling around the edges or shooting in the dark, you are right where you need to be.

There is no need to translate your problem into someone else's idea of logic definition. This instrument uses state syntax directly.

The Pc/La is packaged as a single add-in card for an IBM Pc/XT/AT or compatible. This means that you already own 50% of an efficient, high-performance hardware and software troubleshooting instrument. The other half is yours for less than $2000.00.

The Pc/La - the only logic analyzer to earn the right to use the word *analyze* in its name.



Trigger program to detect 1 of 5 possible faults in the DMA cycle of a MC68000. This example uses only a fraction of the capabilities of the Pc/La.

Destroy all circuit bugs!

© 1988 **V³ Corporation**

Take it from here, now it's......

YOUR MOVE

(416) 266-5511
285 Raleigh Avenue,Toronto, Canada. M1K 1A5

PAL is a trademark of Monolithic Memories Inc., GAL is a trademark of Lattice Semiconductor Corp., LCA is a trademark of Xilinx I.B.M. is a trademark of International Business Machines Corp. Mc68000 is a trademark of Motorola Semiconductor.

Circle 228 on Reader Service Card

this one to anyone with midrange word processing requirements.

I'm also installing a copy of XyWrite III Plus, which I regard as the killer program in the category. It's difficult, ornery, and an ordeal to learn, but once you feel comfortable with it, you can do anything. It's nicely programmable, and the fastest word processor I've seen in a while. Don't give this to your fumble-fingered friend, though; it should have a warning label. I like this program, I use it, but I don't recommend it to anyone who isn't willing to be devoted to it.

Desktop Publishing

I use PageMaker because I can also use the identical program on the Macintosh, but here I give the nod to Ventura Publisher by a tiny margin. I like the way Ventura Publisher allows you to position artwork with the mouse, then fine-tune locations by adjusting actual measurements in a dialog box. This makes up for the imprecision of current screen resolution. PageMaker is not a bad second choice, however, especially now that it uses style sheets and can automatically lay out long documents.

As far as I'm concerned, there are no other contenders in this category.

Spreadsheets

A category brimming with quality. I don't think I've seen a truly bad spreadsheet in years; the technology has been thoroughly assimilated by the industry. What you have to judge is not so much how functions are implemented as which functions are missing. Even the most meager spreadsheet will calculate numeric results, but you'd better know before buying a product whether you need fancy charting or database capacity.

I'm still using VP-Planner Plus. I'm comfortable with it, and Paperback Software treats its customers like royalty. The newest version has speeded up recalculation, the multidimensional database paradigm lets you build sophisticated projections without the need of a huge fenced-off worksheet, and much of the command interface is borrowed from Lotus 1-2-3. A nice product, at a reasonable price.

I keep meaning to learn how to make Microsoft's Excel for the PC jump through a hoop. Though it doesn't have full macro compatibility with 1-2-3, it has the richest environment available for turning a spreadsheet into a job-specific customized application, so I'll be loading Excel onto my fresh hard disk.

But I recommend two other programs. SuperCalc4 is the umpteenth revision of a classic program, fully compatible with 1-2-3, time-tested, quick, and as good a pure spreadsheet as you'll ever find. For most users, though, I actually recommend plain old 1-2-3. Although it has been overshadowed by its imitators, it's still an excellent product. And because of a brilliant design decision by the manufacturer, it's far more than a simple spreadsheet. Its add-in capability makes 1-2-3 a truly special shell for software integration. You can add word processing, dBASE database management, spelling checking, utilities—just about anything. At this point, 1-2-3 has more going for it as an operating system than OS/2.

Database Management

Here, I stick with three favorites I've used before. On the high end, my choice is Paradox (now a Borland product), a fully programmable relational engine

continued

Soft**Safe**™

NEW! POWERFUL SOFTWARE SECURITY SYSTEM LOCKS OUT UNAUTHORIZED PC FILE ACCESSING, VIEWING AND VIRUSES!

EFFORTLESS PC DATA PROTECTION

Four-way security for your valuable PC data.

Hard Disk Access Control. Hard disk data can only be accessed by a password. No viewing, copying or modification by unauthorized users even if PC is booted from diskette. (Up to 8 passwords/users.)

Automatic File Encryption. Simply save sensitive data to designated subdirectories. Encrypted files can only be accessed by the file creator or computer "Owner."

Virus Detection. SoftSafe checks critical system files at every PC start-up and sounds alarm if infection is detected. You can then choose to KILL or IGNORE the virus.

Screen Privacy. When you're interrupted or leave your PC, simply hit the hot-key sequence and your data remains private until you re-enter your password.

only $99^{00}

Installs In Minutes! No Administration Required!

SoftSafe is 100% software, easy-to-use, works on all IBM PC XT/AT,PS/2 and 100% compatibles running DOS 3.0 and up, uses 35K and is *fully guaranteed!*

Order Now by calling toll-free:
(800) 346-7638
In New Jersey: (201) 584-8466
Or see your local dealer.

SDI
Software Directions, Inc.
1572 Sussex Tpke.
Randolph, NJ 07869

BTI88

Circle 209 on Reader Service Card

Items Discussed

AskSam $295
AskSam Systems
119 South Washington St.
P.O. Box 31
Perry, FL 32347
(904) 584-6590
Inquiry 934.

AutoCAD Release 10 .... $3000
Autodesk, Inc.
2320 Marinship Way
Sausalito, CA 94965
(415) 332-2344
Inquiry 935.

Framework III $695
Ashton-Tate
20101 Hamilton Ave.
Torrance, CA 90502
(213) 329-8000
Inquiry 936.

KeepTrack Plus 2.0 .... $99
The Finot Group
2680 Bayshore Pkwy., Suite 101
Mountain View, CA 94043
(800) 628-2828 ext. 700
(415) 966-1900
Inquiry 937.

Lotus 1-2-3 .... $495
Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-8500
Inquiry 938.

MemoryMate $69.95
Broderbund Software
17 Paul Dr.
San Rafael, CA 94903
(415) 492-3200
Inquiry 939.

Microsoft Excel $495
Microsoft Works $149
Microsoft Corp.
16011 Northeast 36th Way
P.O. Box 97017
Redmond, WA 98073
(206) 882-8080
Inquiry 940.

Mirror II $69.95
SoftKlone Distributing Corp.
336 Office Plaza Dr.
Tallahassee, FL 32301
(904) 878-8564
Inquiry 941.

PageMaker $495
Aldus Corp.
411 First Ave. S, Suite 200
Seattle, WA 98104
(206) 622-5500
Inquiry 942.

Paradox $725
Reflex $149.95
SideKick $84.95
Borland International, Inc.
1800 Green Hills Rd.
P.O. Box 60001
Scotts Valley, CA 95066
(408) 438-8400
Inquiry 943.

Procomm Plus $75
Datastorm Technologies, Inc.
1621 Towne Dr., Suite G
P.O. Box 1471
Columbia, MO 65205
(314) 474-8461
Inquiry 944.

Professional Write 2.0 .... $199
Software Publishing Corp.
1901 Landings Dr.
P.O. Box 7210
Mountain View, CA 94039
(415) 962-8910
Inquiry 945.

Q&A $349
Symantec
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600
Inquiry 946.

Ready! $99.95
Symantec Corp.
Living Videotext Division
117 Easy St.
Mountain View, CA 94043
(415) 964-6300
Inquiry 947.

Smart Series $895
Informix Software, Inc.
16011 College Blvd.
Lenexa, KS 66219
(913) 492-3800
Inquiry 948.

SuperCalc4 .... $495
Computer Associates International, Inc.
1240 McKay Dr.
San Jose, CA 95131
(408) 432-1727
Inquiry 949.

TopDOS $69.95
FrontRunner Development Corp.
14656 Oxnard St.
Van Nuys, CA 91411
(818) 376-1322
Inquiry 950.

Ventura Publisher 2.0 .... $895
Xerox Corp.
U.S. Marketing Group
P.O. Box 24
Rochester, NY 14692
(800) 832-6979
Inquiry 951.

VP-Planner Plus $249
Paperback Software International
2830 Ninth St.
Berkeley, CA 94710
(415) 644-2116
Inquiry 952.

XyWrite III Plus $445
XyQuest, Inc.
44 Manning Rd.
Billerica, MA 01821
(508) 671-0888
Inquiry 953.

with a solid application generator and a comprehensive language. Queries are easy to write, and file manipulation is as good as anything competing. Although all the other database development packages I've looked at are pretty amazing, Paradox is to my eye the most consistent and logical. It's not cheap, but it's good.

For smaller projects that don't demand the ultimate in development capability, either Reflex (also from Borland) or Symantec's Q&A are excellent selections. Reflex is the most Macintosh-like product going that doesn't use Microsoft Windows. Designing entry forms and reports is unintimidating, and the program's mathematical and cross-tabula-

continued

How To Support Your Customers

You can provide software updates, answer technical questions, and offer reams of product information to anyone with a modem. 24 hours a day, 7 days a week, ***unattended.***

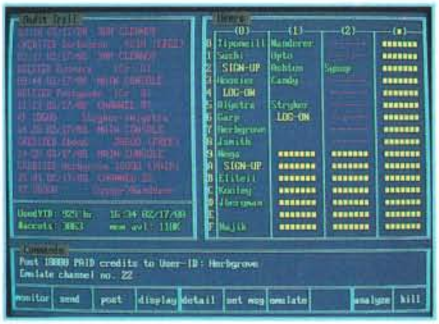
All you need is a PC, XT, AT, or 386-compatible, and a Galacticomm multi-user hardware/software package. And some phone lines.

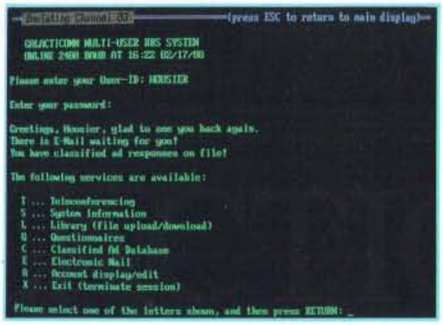
Our multi-user Bulletin Board System software, called ***The Major BBS***™, supports your customers in several ways:

• Public Posting Areas	technical dialogue, bulletins, Q&A listings
• Private E-Mail	for one-on-one customer support
• Teleconferencing	online "seminars" and real-time interaction
• File Upload/Download . .	distribute updates, P.R. info, "app notes"
• Questionnaires	for market research, order forms, etc.

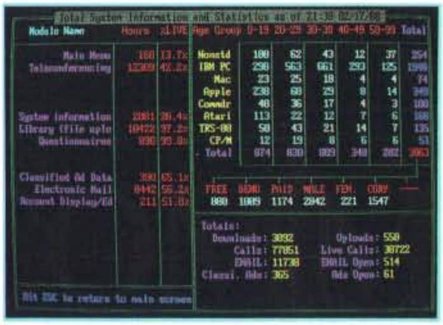
Our multi-modem PC cards are available in several configurations: 2 to 8 modems per card at 2400 baud, or 2 to 16 modems per card at 1200 baud. These are true single-slot cards with the modems built right in — no additional serial ports, power supplies, or external boxes of any kind are required.

The Major BBS can support ***up to 64 users*** simultaneously, although most of our customers operate small 4- to 16-user systems. The C source code is also available, so that you can modify the system to suit your specific requirements.





```
Emulating Channel 33 ───────────(press ESC to return to main display)─

  GALACTICOMM MULTI-USER BBS SYSTEM
  ONLINE 2400 BAUD AT 16:22 02/17/88

Please enter your User-ID: HOOSIER

Enter your password:

Greetings, Hoosier, glad to see you back again.
There is E-Mail waiting for you!
You have classified ad responses on file!

The following services are available:

  T ... Teleconferencing
  S ... System Information
  L ... Library (file upload/download)
  Q ... Questionnaires
  C ... Classified Ad Database
  E ... Electronic Mail
  A ... Account display/edit
  X ... Exit (terminate session)

Please select one of the letters shown, and then press RETURN: _
```



For $59, we'll send you an introductory copy of The Major BBS, suitable for use with your standard COM1 and/or COM2 modems. This is a fully functional version for up to 2 simultaneous users (3 if you count the SysOp). You can upgrade later to a fully supported 4, 8, 16, 32, or 64-user version for only $300 per doubling (plus modem hardware of course!).

Yes! Send me a copy of
THE MAJOR BBS!

Name

Company

Address

City State Zip

(Florida orders add $3.54 tax. Overseas orders add U.S. $25 for shipping.)

☐ $59.00 check enclosed

☐ $67.30 for C.O.D.

☐ $65.15 for credit card:

☐ VISA ☐ MC ☐ AMEX ___/___ Exp. Date

Signature

GALACTICOMM

Galacticomm, Inc. 4101 S.W. 47 Ave.
Suite 101. Fort Lauderdale, FL 33314

Modem: (305) 583-7808
Fax: (305) 583-7846
Voice: (305) 583-5990

Circle 91 on Reader Service Card

DADiSP...

Let Your Instruments Do The Talking.™

Talk to your instruments with **DADiSP-488.** Use over 150 functions to display and analyze your waveforms, as easy as typing a name. Run external data acquisition software, or *your own analysis programs.* Create new functions with DADiSP *Macros.*

the First Spreadsheet designed exclusively for Scientists and Engineers.

(617) 577-1133

Order our $20 Interactive Demo Disk. Ask about DADiSP for IBM-PC/XT/AT, DEC MicroVAX, HP9000, Masscomp 5000, and Sun Workstations. For further information write DSP Development Corporation, One Kendall Square, Cambridge, MA 02139, (617) 577-1133

DSP Development Corporation

tion tools make it ideal for financial analysis. Q&A is the perfect low-stress database product, combining powerful flat-file operation, natural language queries, and even a good word processor for mailing-list management.

I use all three. With products like these, who needs SQL?

Also worth noting is AskSam, a free-form text database product. Although I disliked earlier versions, which seemed to be overly complicated, AskSam Systems has just bolted on a new, simpler interface. I haven't had enough time with it yet to decide how I feel about it, but I'm beginning to think that it has at last achieved star status.

Telecommunications

There are very few bad products for telecommunications; almost anything you can name will get the job done, unless you've got exceptionally demanding criteria. I like and use both Mirror II and Procomm Plus. Mirror II operates in the background, and its script language has steadily improved to become absolutely amazing. Want to write a bulletin board system (BBS) with a high-level language geared to telecommunications and run it in the background while you work on your spreadsheet? You got it. Impressive. Procomm Plus is just a top-notch all-around package. Supports every protocol you ever imagined. Effortless to use.

Recommendations? Anything that isn't Microsoft Access.

Drafting

Simple. AutoCAD.

Painting

I haven't seen a single PC program that comes close to what's available on the Mac. Sorry.

Utilities

Were I starting to populate my hard disk without benefit of backup disks, I'd begin by picking up the necessary public domain utilities from a users group, a BBS, or a friend. I'm particularly fond of one that's a handy substitute for the `DIR` command. Modeled after Unix's `LS` command, it displays file directories in lowercase (much more readable than MS-DOS's all-caps format) and accepts a whole bunch of parameters that let me sort by name, size, or date; list programs and batch files only; show the status of read/write, system, and archive flags; and so on.

I'm now so used to typing `LS` instead of `DIR` that I feel lost without the program. There is also a number of shareware command stack editors that let me use the keyboard to retrieve and edit the DOS commands I've used recently (convenient for repetitive operations).

If you want a commercial product to handle DOS operations, I'd recommend FrontRunner's TopDOS, a memory-resident utility that provides both directory display and command history features, as well as a built-in editor that beats EDLIN by a mile, facilities for mass copying and deletion of files, command aliasing, and shortcuts for anything else you want to do at the DOS level. I use KeepTrack Plus from The Finot Group for hard disk maintenance and backup; it's neither as fast nor as slick as some of its competitors, but it backs up files as pure DOS rather than any proprietary format, and it doesn't crash.

Picking utilities is the most personal aspect of personal computing. Your choice in these little programs is what gives your system its flavor. I avoid suggesting utilities; it's like commenting on haircuts—you can't win.

Pop-Ups

Memory-resident programs on a PC system are a nightmare that's been well documented in this column and elsewhere. I try to keep my use of the contentious little devils to a bare minimum, and I'm staying with MemoryMate and Ready!. MemoryMate is a bare-bones text database program that lets you store 60-line records and dig them up by searching on any string. Not fancy, but it's a great way to keep your random jottings under control. When I need outlining, I'll switch to Ready!.

However, I recommend the original SideKick (if you can still find a copy). It's the program that started the whole pop-up trend, and its elegant design for note taking and scheduling makes it an absolute classic.

Final Thought

There you have it. The products I've mentioned all represent sound programs that do what they're supposed to do. It's not a "10 Best" list, but it's what I tell people who ask. And I'm beginning to listen to my own advice at last. ■

Ezra Shapiro is a consulting editor for BYTE. You can contact him on BIX as "ezra." Because of the volume of mail he receives, Ezra, regretfully, cannot respond to each inquiry.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

COMPUTERS FROM IOWA?

Gateway 2000 is centrally located in order to efficiently serve the entire country. We are honest, hard working, well educated people, committed to succeeding and growing in the highly competitive micro-computer market.

Gateway 2000 is a full-service and support organization that realizes the key to our success lies in a satisfied customer base.

One look at the configurations we have listed below and you will see that we have high quality equipment at incredible prices. We have many different configurations available as well as a complete line of software and peripherals. So call one of our knowledgeable salespeople for more information.

We look forward to doing business with you, and establishing a long term business relationship.

16 Mhz 286 EGA SYSTEM

80286-16 Processor
1 Meg 0 Wait State RAM
1.2 Meg Floppy Drive
1.44 Meg Diskette Drive
40 Meg Seagate ST251
Samsung EGA Monitor w/Card
2-Parallel/2-Serial Ports
101 Key Enhanced Keyboard
DOS 3.3 w/GWBasic
1 Year Warranty
30 Day Money Back Guarantee

$2295.00

20 Mhz 386 VGA SYSTEM

80386 Processor Running at 20Mhz
1 Meg 60 NS Ram (Expandable to 8 Megs)
1.2 Meg Floppy Drive
1.44 Meg Diskette Drive
80 Meg Seagate ST4096 (28MS)
1 to 1 Interleave Controller
Samsung Multisynch Monitor
EVEREX EVGA Board
2-Parallel/2-Serial Ports
101 Key Enhanced Keyboard
Tower Case w/275 Watt Power Supply
80287 and 80387 Sockets
DOS 3.3 w/GWBasic
1 Year Warranty
30 Day Money Back Guarantee

$3795.00
Call For 25 Mhz Option

GATEWAY 2000

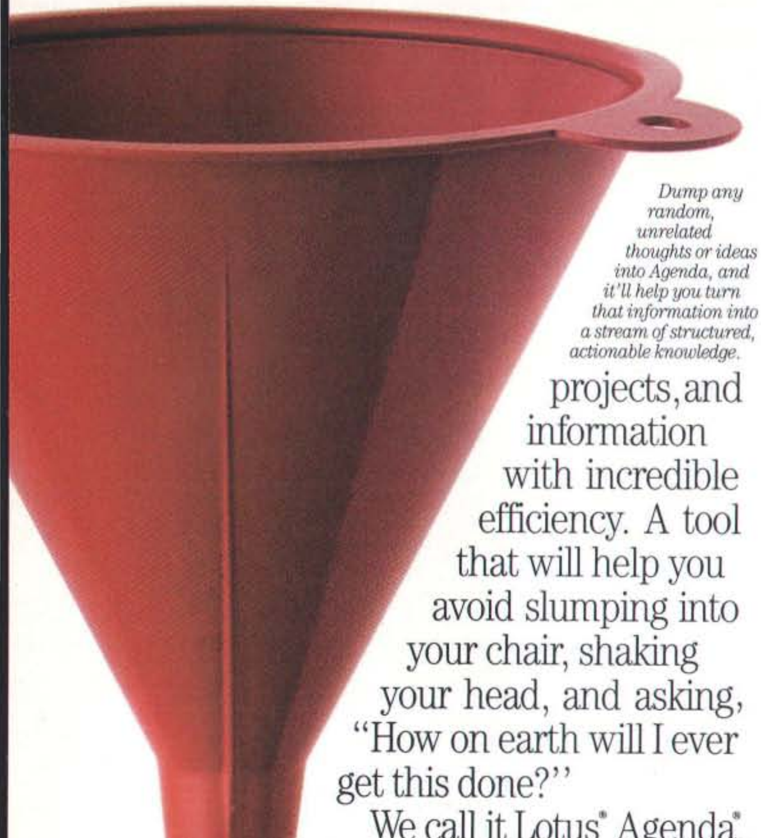
Gateway 2000 • P.O. Box 2414 • Sioux City, IA 51107
800-233-8472/712-255-7899

Due to the volatility in the DRAM market, all prices are subject to change.

This is for ev
too busy to get

If you're the type of person who's too busy to read an ad, read this ad.

Because you'll learn about a new tool that will help you manage people, ideas, projects, and information with incredible efficiency. A tool that will help you avoid slumping into your chair, shaking your head, and asking, "How on earth will I ever get this done?"



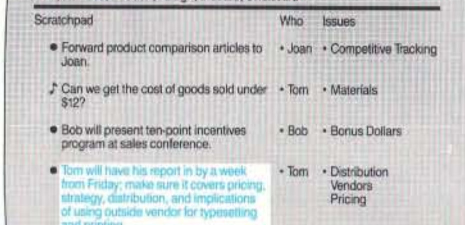
Dump any random, unrelated thoughts or ideas into Agenda, and it'll help you turn that information into a stream of structured, actionable knowledge.

We call it Lotus® Agenda®, the personal information manager.

Agenda allows you to dump random facts, thoughts, and ideas into your PC without having to structure the information in advance.

Agenda's filing system is a more sophisticated version of this filing system. You can put items anywhere you want. View them any way you want. And have access to them anytime you want.

You can record the thousands of tasks you need to address to put together a new product line. Or the thousands of factors you need to put together a new bottom line.


File View Item Category Print Utility System Quit
New, Remove, Position, Assign, Discard, Undiscard

Scratchpad	Who	Issues
• Forward product comparison articles to Joan.	• Joan	• Competitive Tracking
♪ Can we get the cost of goods sold under $12?	• Tom	• Materials
• Bob will present ten-point incentives program at sales conference.	• Bob	• Bonus Dollars
• Tom will have his report in by a week from Friday; make sure it covers pricing, strategy, distribution, and implications of using outside vendor for typesetting and printing.	• Tom	• Distribution Vendors Pricing
• Decision needed on research budget by end of this week—discuss options with Jim and Joan.	• Jim Joan	• Research

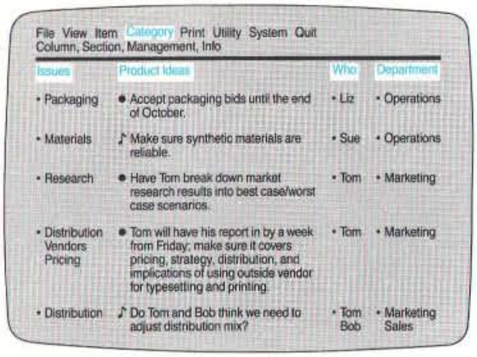
Items. Dump information in manually, import it or use our pop-up capability while in another program.

Agenda will not only file these random items of information for you, it'll help you arrange them any way you want.

So you can understand them better, formulate new ideas better and extract all the answers you need better.

Which means, now you can concentrate

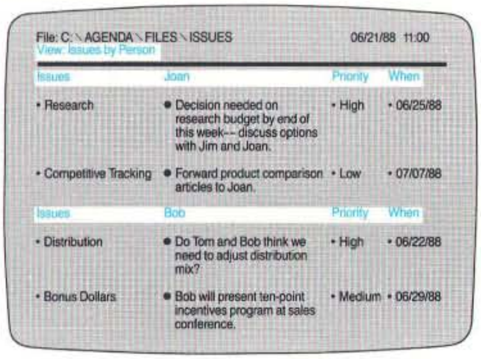
eryone who's any work done.



File View Item Category Print Utility System Quit
Column, Section, Management, Info

Issues	Product Ideas	Who	Department
• Packaging	● Accept packaging bids until the end of October.	• Liz	• Operations
• Materials	♪ Make sure synthetic materials are reliable.	• Sue	• Operations
• Research	● Have Tom break down market research results into best case/worst case scenarios.	• Tom	• Marketing
• Distribution Vendors Pricing	● Tom will have his report in by a week from Friday; make sure it covers pricing, strategy, distribution, and implications of using outside vendor for typesetting and printing.	• Tom	• Marketing
• Distribution	♪ Do Tom and Bob think we need to adjust distribution mix?	• Tom Bob	• Marketing Sales

Categories. Agenda files items in all relevant categories so you can always find the information you need.



File: C:\AGENDA\FILES\ISSUES 06/21/88 11:00
View: Issues by Person

Issues	Joan	Priority	When
• Research	● Decision needed on research budget by end of this week-- discuss options with Jim and Joan.	• High	• 06/25/88
• Competitive Tracking	● Forward product comparison articles to Joan.	• Low	• 07/07/88

Issues	Bob	Priority	When
• Distribution	● Do Tom and Bob think we need to adjust distribution mix?	• High	• 06/22/88
• Bonus Dollars	● Bob will present ten-point incentives program at sales conference.	• Medium	• 06/29/88

Views. Looking at the same information through different views gives you a more informed perspective.

more on using and acting on your information. And less on processing it.

How does Agenda work?

First, enter your items of information

The whole idea behind Agenda is to get them all in a row.

into your PC and assign them to categories that you create.

Then Agenda will do all of your filing automatically. And thanks to Agenda's *multiple filing capabilities*, if the information is relevant in more than one place, Agenda will take it and put it in several categories at once.

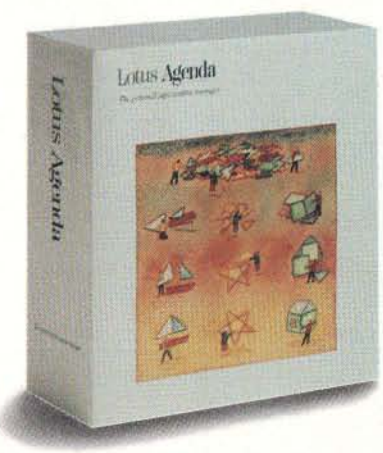
This makes it easy to view your data in different ways so you can pinpoint information that's important to you. Or discover new relationships you hadn't considered before. And anytime you change an item in a view, Agenda will automatically update all other categories where the item has been assigned.

In fact, you could say that Agenda recalculates your text the way a spreadsheet program recalculates numbers.

All of which means, from now on you'll be able to come in every morning, check your Agenda, and get right to work.

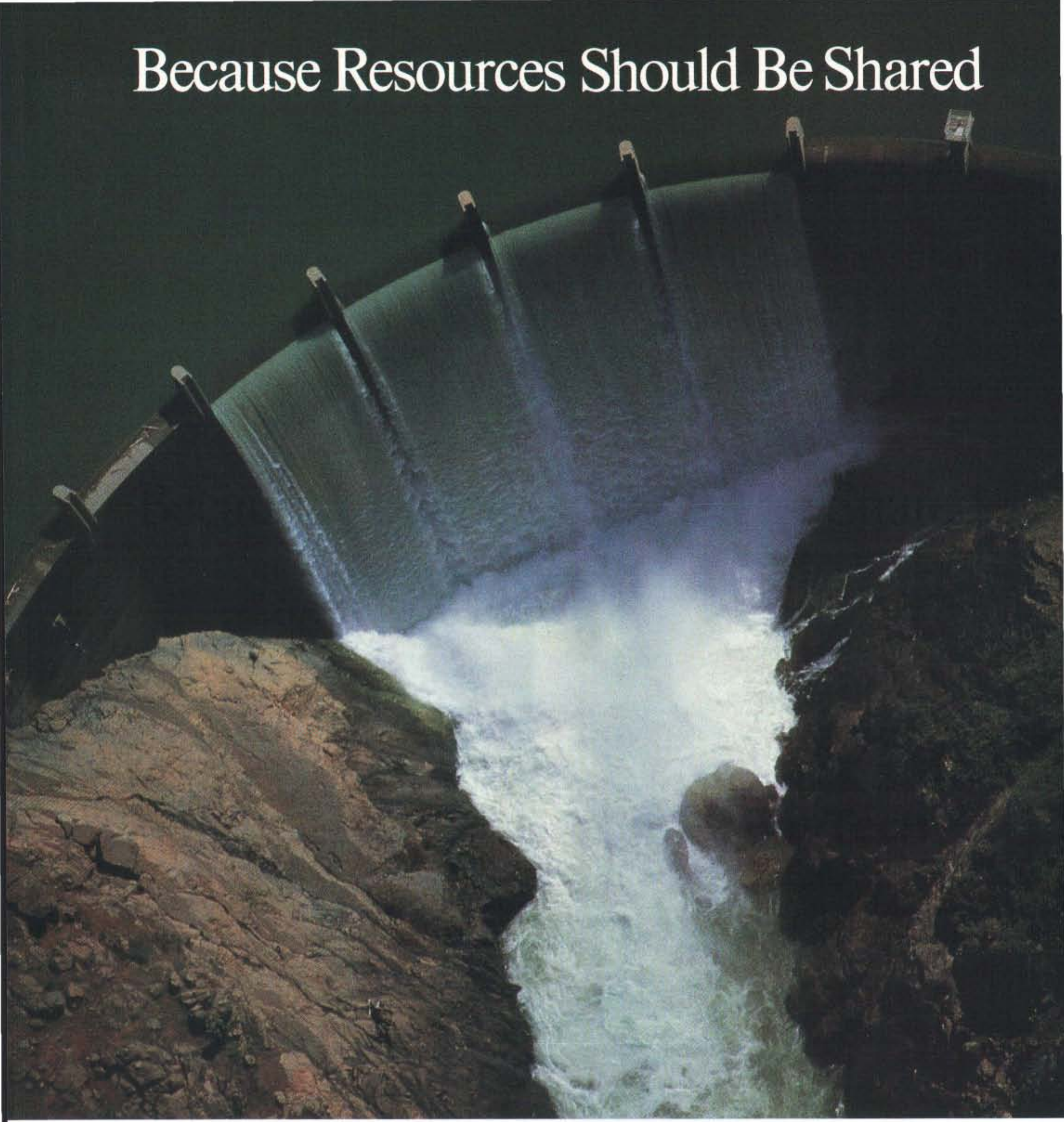
Because you'll immediately know what work needs getting to.

For $15, we'll send you an Agenda demo kit or videotape. Call **1-800-345-1043** and ask for demo kit AGU-3058 for the 3.5″ version or AGU-3053 for the 5.25″ version. Or ask for videotape AGU-3063.



Introducing Lotus Agenda

Agenda and Agenda Demo Kit require an IBM® PC or compatible, with 640K and a hard disk, DOS 2.0 or higher. Lotus and Agenda are registered trademarks of Lotus Development Corporation. IBM is a registered trademark of IBM Corporation.



BayTech engineers Printer Sharing.

Make the most of your investments in valuable printers, computers, plotters, modems, and other resources with a printer-sharing device from BayTech. We manufacture a diverse product line engineered for flexibility and speed that lets you share your resources and maximize your investments.

From simply sharing one or more printers between computers, to creating a complete network for printer sharing and computer-to-computer communication, BayTech has a device designed to meet your specifications.

Call toll free today to learn more about maximizing your resources.

Circle 23 on Reader Service Card

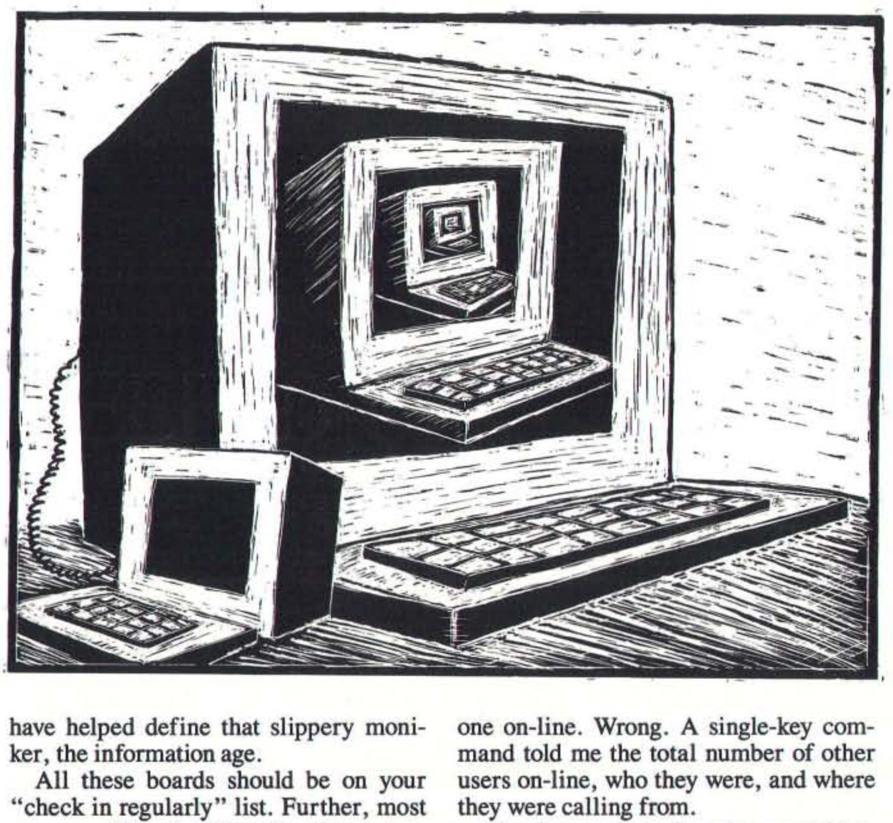
BayTech

Bay Technical Associates, Inc.,
Data Communications Products Division
200 North Second St., P.O. Box 387,
Bay Saint Louis, MS 39520 USA
Telex: 910-333-1618 BAYTECH.
Telephone: 601-467-8231 or toll-free
800-523-2702, EXT 981

COM1: ■ Brock N. Meeks

BEEFED-UP BULLETIN BOARDS

The offspring of yesterday's bulletin boards are sophisticated, powerful systems with plenty to offer PC users



The Dark Ages of microcomputer-based communication stretch back 6 years, tops. Back then, all bulletin board systems (BBSes) looked alike. They were single-line, dual-floppy, unstable, kludgy electronic beasts. For sysops, they were a challenge requiring the dedication of an unrequited love affair. For users, they were electronic labyrinths, the next best thing to an interactive adventure game. Not any more.

Today, the garden-variety BBS is as rare as a Susan B. Anthony silver dollar. The BBS has been constantly evolving ever since Ward Christensen and Randy Suess first used their homegrown BBS to squirt binary files back and forth. Their system evolved as a way to overcome the nightmarish logistics of traveling some 50 miles between their homes just to trade updates of the software they were both working on. And nowhere is that evolution more evident than in today's "power BBSes."

These power BBSes often sport multiple dial-up lines capable of handling up to 50 users at a time. Their on-line storage capacity is mind-boggling. And sysops have even carved out full-time careers (and $50,000 or $60,000 incomes) simply from charging modest subscriber fees.

Most of the boards I'll profile here belong to this power category. The remainder aren't quite beefed-up to such power levels, but they are important boards for their software libraries. All are powerful grass-roots communications tools that have helped define that slippery moniker, the information age.

All these boards should be on your "check in regularly" list. Further, most are accessible via Telenet's all-you-can-eat $25 per month, flat-fee, packet-switched service, PC Pursuit. This network gives you access to any computer service in 24 major metropolitan areas in the U.S. (For more information about PC Pursuit, call (800) 835-3001.)

Exec-PC

How important is the Exec-PC BBS? To borrow a line from a famous hamburger chain, I was the 1,282,770th caller served. And I do mean "served." Exec-PC is perhaps the premier BBS in the nation for exchanging software.

For starters, Exec-PC has some 54 dial-up lines. My first log-on saw me in the company of 30 other users hailing from 10 different states. I discovered this fact only after I became suspicious of the board's speed. I thought I was the only one on-line. Wrong. A single-key command told me the total number of other users on-line, who they were, and where they were calling from.

The board contains the complete, fully accessible, PC-SIG (special-interest group) software library on CD-ROM. Hard disk storage space is 1.48 gigabytes. Over 700 files are dedicated to Unix and Xenix. In all, there are more than 50,000 individual software files (most of them in .ARC format) for you to peruse and download. First-time users are allowed 30 minutes on the system in what the board calls "demo mode." This mode is for unregistered users; registered users have unlimited access.

During your first sign-on, you can

- Download files from the free file area.
- Leave comments to the sysop at log-off.
- Read messages only in the main IBM conference.

continued

ILLUSTRATION: CLAUDIA TANTILLO © 1988

Circle 24 on Reader Service Card

Two ways to write superior documents using Microsoft Windows

The Thesaurus & Speller for Microsoft Windows $119.95

The *Thesaurus & Speller* provides thorough reference sources for the English language, including phonetic correction, meanings, synonyms and other parts of speech. 1,400,000 responses are available using our database, providing you with one of the largest thesaurus works on the market. *Also available for $89.95 using 470,000 responses.*

Spelling correction of several document types, including *Microsoft Write* and *Microsoft Word,* is quick and easy. Expansion is easy too; words not found in the 80,000 word base dictionary may be added into any of several user dictionaries.

Windows Folio Word Processing for Microsoft Windows $199.95

Windows Folio is a full-featured word processor designed to make maximum use of the features of *Microsoft Windows.* Style sheets, automatic footnote placement, a graphic user interface, an integrated version of the *Thesaurus & Speller,* and maximum flexibility when formatting your document are only a few of the features packed into our *Windows Folio* word processor.

Beckman Associates
928 Oakcrest Street, Suite A,
Iowa City, Iowa 52246
Call 319-354-5116
for information or to order!

Microsoft® is a trademark of Microsoft Corporation.
Beckman Associates® is a trademark of Beckman Associates.

Items Discussed

Exec-PC
Operation: 24 hours a day, 365 days a year
Phone: (414) 964-5160
Sysop: Bob Mahoney
PC Pursuit Access: Yes
Audience: IBM only
Access: Free, 30 minutes; subscriber fee for full access
Communications requirements: 300/1200/2400 bps; full duplex, no parity, 8 bits, 1 stop bit
Inquiry 862.

Invention Factory
Operation: 24 hours a day, 365 days a year
Phone: (212) 431-1194 (free-access line)
Sysop: Mike Sussel
PC Pursuit Access: Yes
Audience: IBM only
Access: Free-access line with full download privileges; subscriber fees for unlimited access
Communications requirements: 300–9600 bps; full duplex, no parity, 8 bits, 1 stop bit
Inquiry 863.

Thousand Oaks Technical Database
Operation: 24 hours a day, 365 days a year
Phone: (805) 493-1495
Sysop: Trevor Marshall
PC Pursuit Access: No
Audience: IBM only
Access: No subscriber fees
Communications requirements: 300–2400 bps; full duplex, no parity, 8 bits, 1 stop bit
Inquiry 864.

Utilities Exchange
Operation: 24 hours a day, 365 days a year
Phone: (614) 488-3991
Sysop: Mike Koehler
PC Pursuit Access: No
Audience: IBM only—anyone needing any type of software utility program
Access: Limited free access, subscriber fee for unlimited access
Communications requirements: 300–2400 bps; up to 9600 bps for owners of USRobotics HST modems; full duplex, no parity, 8 bits, 1 stop bit
Inquiry 865.

- List the directories of files available for transfer.
- Use the Barndt database search system to find files.

For the uninitiated, the Barndt database search system is a proposed standard for naming files. Anyone who has spent even a small amount of time banging around a hard disk looking for specific types of files will appreciate the Barndt system. Many of the BBSes across the land now employ this system. You can read all about it in a text file under the extensive on-line help section. The file explains the theory behind the system and the indexing system. It's required reading if you're serious about making your on-line life more efficient.

Invention Factory

The Invention Factory is one of the true survivors of the BBS community, given the high fatality rate of BBSes in general. According to sysop Mike Sussel, the board has been on-line for 5 years and has been down only once. It comes in a close second for the most power-packed board in the nation, the first being the Exec-PC.

The board allows you 30 free minutes a day for downloading. However, for every minute you spend uploading a program, your downloading credit increases by a factor of 2. There are no fees for this privilege. A yearly fee of $100 ($8.33 a month) gives you unlimited access every day. Sussel says that paid subscribers are guaranteed never to get a busy signal.

The Invention Factory has 24 dial-up lines (2 free and 22 subscriber). There are over 8000 files available, representing over 41,000 individual files. The system also has 1.2 gigabytes of hard disk storage.

The free-access lines operate at data rates of 300 or 1200 bits per second; subscribers can access the system at data rates of up to 9600 bps if they have a Hayes V-series modem. Sussel says that data transfer rates of up to 19.2K bps are possible for V-series owners using the ZMODEM transfer protocol.

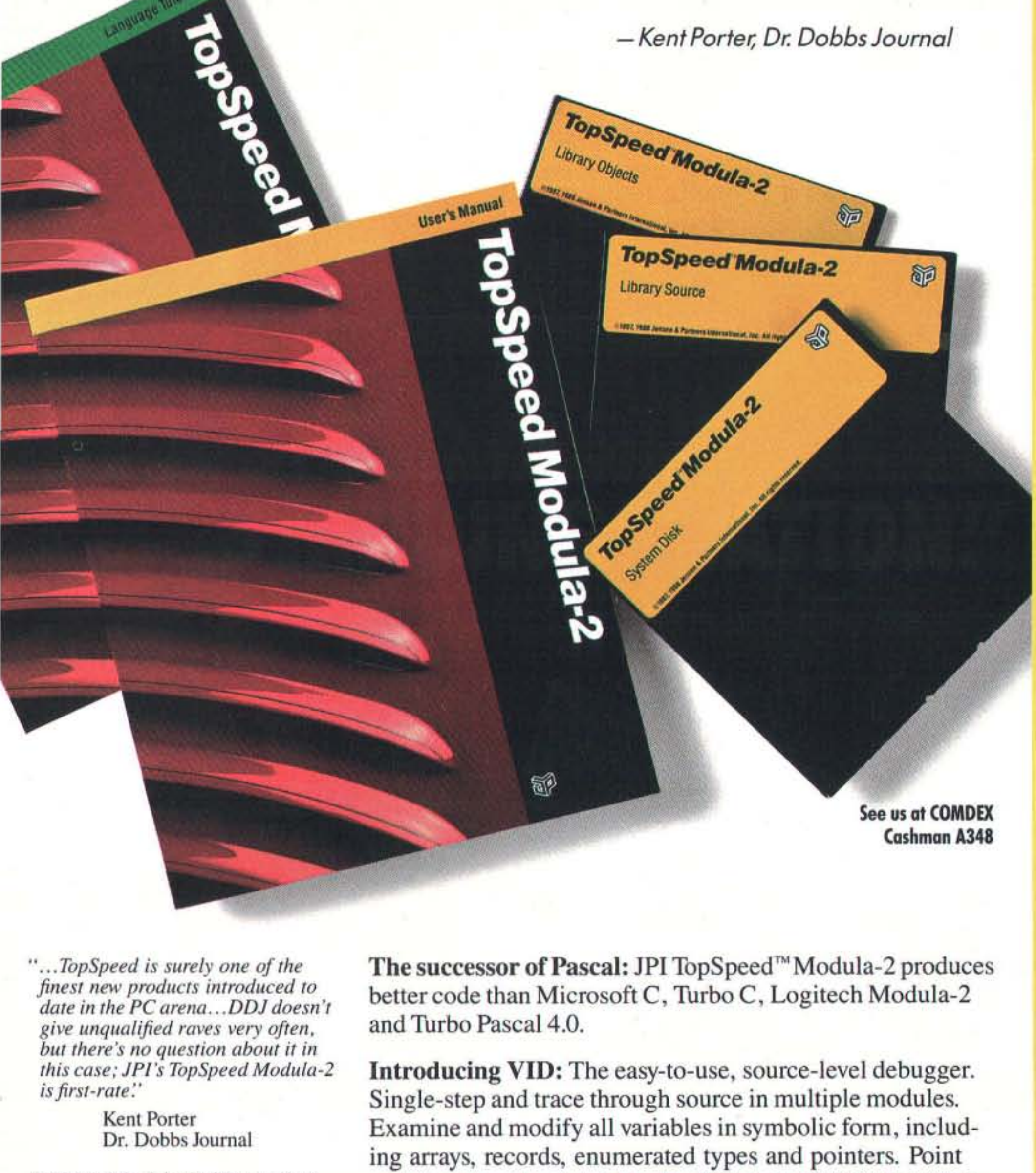
The board contains 76 different file areas that encompass such diverse topics as amateur radio, OS/2, and local-area networks (LANs).

The board also supports "doors" or special programs that you can execute while on-line. One of these doors, called Qwikmail, lets you automatically scan

continued

"TOPSPEED EARNS A STANDING OVATION!"

—Kent Porter, Dr. Dobbs Journal



See us at COMDEX
Cashman A348

"*...TopSpeed is surely one of the finest new products introduced to date in the PC arena...DDJ doesn't give unqualified raves very often, but there's no question about it in this case; JPI's TopSpeed Modula-2 is first-rate.*"

Kent Porter
Dr. Dobbs Journal

"*JPI Modula-2 looks like another classic in the making. It generates code as good as or better than leading C compilers and the programming environment is a genuine pleasure to use.*"

Dick Pountain
BYTE Magazine

"*I liked all of the hard-disk space that was recovered after I deleted my BORLAND, MICROSOFT, and LOGITECH compilers, because with TopSpeed Modula-2 all the rest are obsolete.*"

Robert D. Randall
Donnelley Marketing

In England and Europe contact:
Jensen & Partners UK Ltd., 63 Clerkenwell Road, London EC1M 5NP. Phone: (01)253-4333. Compiler Kit: £59.95, TechKit £34.95, VID £34.95, 3-Pack £109.95.
Handling charges:
In UK, add £2 for each product ordered. VAT will be added on software. In Europe, add £4 for up to 3 products, £2 for each add'l product.

The successor of Pascal: JPI TopSpeed™ Modula-2 produces better code than Microsoft C, Turbo C, Logitech Modula-2 and Turbo Pascal 4.0.

Introducing VID: The easy-to-use, source-level debugger. Single-step and trace through source in multiple modules. Examine and modify all variables in symbolic form, including arrays, records, enumerated types and pointers. Point and shoot breakpoints including "One-shot," "Sticky," "Delayed," and "Monitor." Watch both variables and Modula-2 expressions during execution. Automatic variable trace of all variables accessed, and assembler, registers and procedure call-stack trace windows. Package includes symbolic disassembler and execution profiler. 72-page manual.

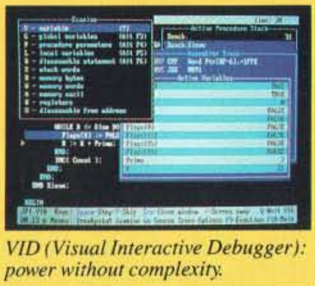
The Compiler Kit includes: High-speed optimizing compiler (3,000-5,000 lines/min. on a PC AT 8MHz), integrated menu-driven environment with multi-window/multi-file editor, automatic *make,* fast smart linker. All Modula-2 sources to libraries included. BONUS: Complete high-speed window management module included with source. 258-page User's Manual and 190-page Language Tutorial.

The TechKit™ includes: Assembler source for start-up code and run-time library, JPI TopSpeed Assembler (30,000 lines/min.), TSR module, communications driver, PROM locator, dynamic overlays, and technical information. 72-page manual.

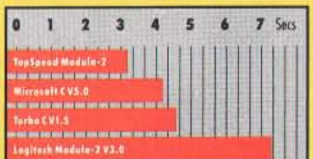
System Requirements: IBM PC or compatible, 384K available RAM, two floppy drives (hard disk recommended).

Circle 118 on Reader Service Card

Seamlessly integrated OS/2 version coming soon.



VID (Visual Interactive Debugger): power without complexity.



Sieve benchmark measured by the British Standards Institution (BSI)—25 iterations on an 8MHz AT.

Compiler Kit $99.95
TechKit $59.95
VID $59.95

3-Pack $179.95
(Compiler, TechKit & VID)

To Order:
In the US, call:
1-800-543-5202
In Canada, call:
1-800-543-8452
Or mail us your order with a check, money order, or VISA/MC information. 30-day unconditional money-back guarantee.

Shipping & handling charges:
In North America: add $5, plus $2 for each add'l product. CA residents please add applicable sales tax. Overseas: add $20, plus $8 for each add'l product.

Jensen &
Partners
International

1101 San Antonio Rd.
Suite 301
Mountain View, CA 94043
Phone: (415)967-3200

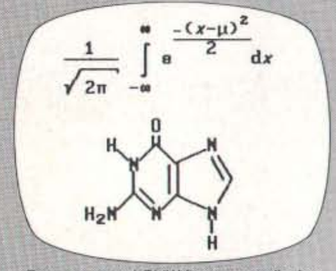
TopSpeed and TechKit are trademarks of Jensen & Partners International. Other brand and product names are trademarks or registered trademarks of their respective holders.

Circle 108 on Reader Service Card

ChiWriter

NOW WITH MICROSPELL

How are you currently producing your scientific documents? Are you using a "golf ball" style typewriter? A regular word processor, hand lettering the special symbols? Are you fighting against a "what-you-see-is-definitely-not-what-you-get" system with a special command language? Or are you using one of our competitors' expensive and inflexible programs? Find out how ChiWriter can solve your scientific word processing problems.



From an actual ChiWriter screen display

Powerful Scientific/Multifont Word Processing at a Reasonable Price

ChiWriter is a complete word processor, designed especially for scientific and foreign language text. Its features include: intuitive formula editing commands, automatic pagination, variable headers and footers, footnotes, box draw mode, a notepad window, and an integrated spelling checker.

Best of all, ChiWriter is completely "what-you-see-is-what-you-get." Even complicated formulas can be entered easily because the screen display corresponds exactly to the printout.

ChiWriter runs on an IBM PC with CGA graphics, 2 floppy or 1 hard/1 floppy drive, and an Epson/IBM compatible 9 pin printer. Hi res screen suport (Hercules, EGA, VGA, AT&T), 24 pin printer support, and laser printer support (HP LaserJet, PostScript) are available.

"Chi Writer is a nifty product with a price I defy you to beat and performance I defy you to snub... I know of several $500 programs that will do the job, but for the same money you could buy ChiWriter and a vacation"
Phil Wiswell, PC Magazine

☐ ChiWriter Program $24.95	$99.95
☐ Hi Res Screen Support	$24.95
☐ 24 Pin Printer Support	$24.95
☐ Laser Printer Support	$59.95
☐ International Keyboard Support	$19.95
☐ Chemistry Support	$49.95
☐ Word Perfect Converter	$49.95
☐ Conographic Font Set	$149.95
☐ MergeChi Mail Merge Facility	$24.95
☐ IndexChi Index Generator	$59.95
☐ Shipping & handling	$______

$5 U.S. & Canada, $10 Europe, $15 elsewhere

Name ________________

Address ________________

City ________________

State _____ Zip ______ Country _______

Phone (   ) __________

Payment by ☐ Check ☐ Purchase Order ☐ VISA ☐ MC

Card # ____________ Exp. ___/___

"BSP88"

Horstmann Software Design Corporation
140 E. San Carlos St./P.O. Box 5039
San Jose, CA 95150-5039, USA
(408) 298-0828

horstmann software

each of the message bases for any messages left since your last log-on. Qwikmail then compiles all those messages (including any electronic mail you have waiting) into one .ARC file that you can then download using your choice of protocol, including YMODEM BATCH or ZMODEM.

Sussel and two assistant sysops spend an average of 100 hours a week combing the several BBSes from coast to coast looking for the newest and best software available. This process ensures that the file database is always up to date.

Thousand Oaks Technical Database

The Thousand Oaks board will be familiar to "old-timers" because it is modeled on the venerable RCP/M (remote CP/M) system, a BBS program for the CP/M operating system. Under RCP/M software, you essentially sit at your computer keyboard and issue the same commands you would if you were controlling DOS directly. This means you type `DIR` to view the file directory and `TYPE` to read ASCII files. Obviously, any command that is potentially dangerous (e.g., `DELETE` and `FORMAT`) is locked out.

The system's primary drawing point is the PC-SIG CD-ROM that is fully accessible for downloading. You'll find the CD-ROM listed as drive 1. The hard disks are C, D, E, F, and G. They have a combined storage capacity of 160 megabytes. The CD-ROM is organized into subdirectories in a tree structure that tries to group like files in the same location. For instance, on drive C, if you choose the 68000 path, depending on your interests, you can then go to either Amiga, Atari, or CPM68K. These subdirectories are shown on the directory display as `68000/amiga/atari/cpm68k/`.

As the system warns, if you don't know how to use the `Change Disk` command, you should consult your MS-DOS manual before attempting an on-line session here. The best way to find out what software is available on this system is to transfer the file catalogs on drive E and read them on your machine.

To keep the system reasonably accessible, when accessing the CD-ROM, you are allowed only 15 minutes to download. I found this time more than adequate. The 15-minute limit lets you download what amounts to one entire PC-SIG floppy disk. If you get greedy, you'll have to wait 24 hours before coming back for a CD-ROM fix.

Utilities Exchange

True confessions time: I'm a utilities freak. I love all those little programs created under the adage "Necessity is the mother of invention." And the Utilities Exchange board is dedicated to utility programs—up to 117 megabytes of dedication, to be exact.

Sponsored in part by the Columbus (Ohio) Computer Society, this board offers limited free access to everyone. But those who choose to subscribe receive unlimited access for a fee of $25 per year.

Free-access users are allowed 45 minutes of time on the board and up to 256K bytes of downloads per day. You can view a full listing of the board's files off-line by just downloading a file called UEFILES.ARC. This file is updated daily. And from my extensive romp through the board's files, you won't find a better selection of utility programs anywhere.

The board also runs a door called Prodoor, which has a handy feature called ARCM (which stands for arc mail) that allows you to archive all your messages into a single file for more efficient downloading.

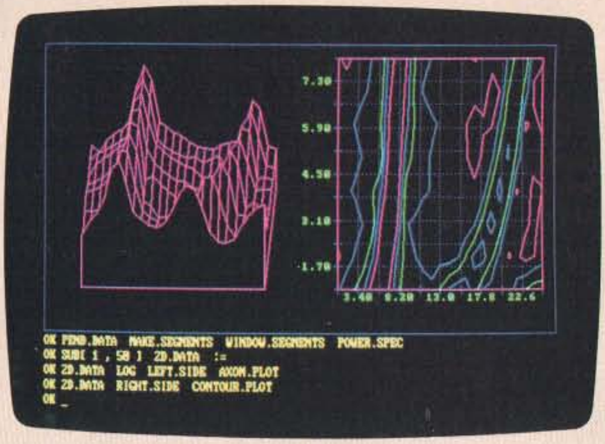
This program board's 117 megabytes of storage are divided into 28 separate categories of utilities. Here you'll find utilities for every possible application, from AT386 to diagnostics to LANS to word processors. A nice touch provided by the Utilities Exchange is an open software library that contains programs written by Columbus-area software authors. This idea should be adopted by every BBS that serves an active shareware author community.

Currently, there are an estimated 10,000 BBSes on-line across the nation. With this many boards up and running, there are BBSes providing formidable software libraries that rival those I've outlined. The ones I mention here are simply reference points—a clearinghouse, if you will. And even if you never venture beyond these boards, you'll not want for a steady diet of the most up-to-date and innovative software programs that are being written today.

Whether you call it the hacker ethic or the shareware spirit, these BBSes represent a basic element in the evolution of microcomputer-based telecommunications: powered up, pushing on. ■

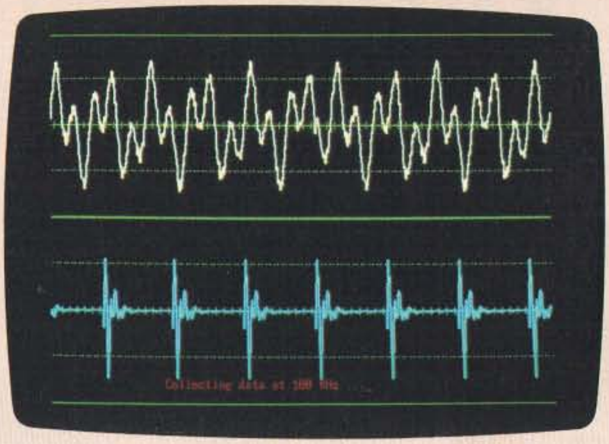
Brock N. Meeks is a San Diego–based freelance writer who specializes in high technology. You can reach him on BIX as "brock."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

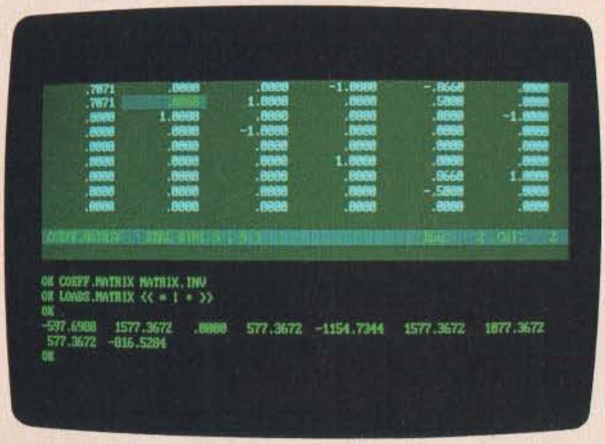


```
OK FEND.DATA  MAKE.SEGMENTS  WINDOW.SEGMENTS  POWER.SPEC
OK SUB[ 1 , 50 ]  2D.DATA  :=
OK 2D.DATA  LOG  LEFT.SIDE  AXON.PLOT
OK 2D.DATA  RIGHT.SIDE  CONTOUR.PLOT
OK _
```

Single commands like CONTOUR.PLOT instantly generate presentation-quality graphics.

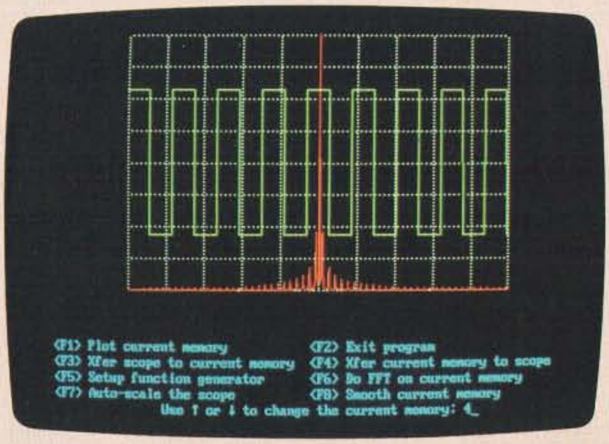


With proper hardware, ASYST acquires data at rates of up to 250KHz.



```
   .7071        .0000        .0000      -1.0000       -.8660        .0000
   .7071        .0000       1.0000        .0000        .5000        .0000
   .0000       1.0000        .0000        .0000        .0000      -1.0000
   .0000        .0000      -1.0000        .0000        .0000        .0000
   .0000        .0000        .0000        .0000        .0000        .0000
   .0000        .0000        .0000       1.0000        .0000        .0000
   .0000        .0000        .0000        .0000        .0660       1.0000
   .0000        .0000        .0000        .0000       -.5000        .0000
   .0000        .0000        .0000        .0000        .0000        .0000

OK COEFF.MATRIX MATRIX.INV
OK LOADS.MATRIX << = ! = >>
OK
-597.6988   1577.3672   .0000   577.3672  -1154.7344   1577.3672   1877.3672
 577.3672  -816.5284
OK
```

It takes just one command and 47 milliseconds to calculate the inverse of a general 9 x 9 matrix.



```
<F1> Plot current memory              <F2> Exit program
<F3> Xfer scope to current memory     <F4> Xfer current memory to scope
<F5> Setup function generator         <F6> Do FFT on current memory
<F7> Auto-scale the scope             <F8> Smooth current memory
           Use ↑ or ↓ to change the current memory: 4_
```

Join the thousands of users who get significantly faster solutions with ASYST.*

Screen Tests.

Go ahead.

Try this with any other single PC software package.

Sure, you could create these screens by using several scientific software packages. (Of course, you'd have to learn several different systems and convert your data files a few times.) But we did it all with just one, integrated, scientific software tool. A tool that can handle all your needs—data acquisition, analysis, and graphics—ASYST.

ASYST gives you full control of your data. Within one, unique, interactive programming environment you have access to high-level commands that allow you to perform functions like instrument interfacing and control, FFTs, smoothing, integration, differentiation, curve fitting, statistics, and matrix and polynomial operations.

But even though the ASYST function set is extensive, you're not tied to it. You can expand and customize the functionality of ASYST by tailoring its capabilities to your needs. And you'll find, as thousands of satisfied users have, that you don't have to be a professional programmer to use it.

And just in case you need it, you'll appreciate our 60 days of *free* technical support. Ongoing support is available.

Test ASYST on your own screen with our 30-day no-risk offer. Call 1-800-348-0033.

A complete system:

- Data analysis and statistics
- Acquisition (A/D, D/A, and Digital I/O)
- Instrument interfacing and control (IEEE-488/GPIB and RS-232)
- High-performance graphics

Circle 19 on Reader Service Card

System Developers: Ask about the ASYST Run-time and User site licenses.

*1024 point complex FFT calculated in 422 milliseconds. All benchmarks based on a 20MHz 386 computer with 387 coprocessor.

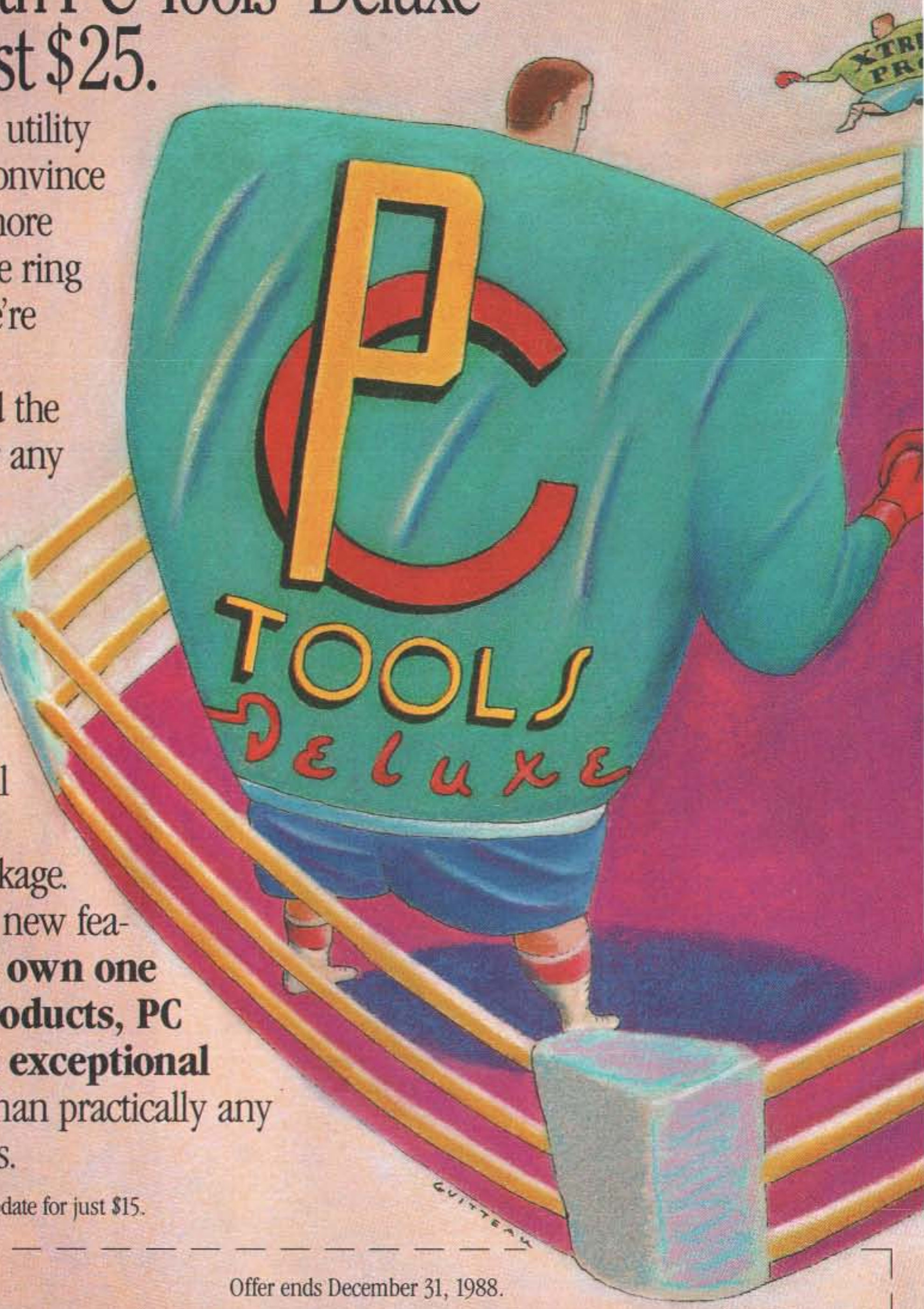
ASYST
SOFTWARE TECHNOLOGIES, INC.
100 Corporate Woods, Rochester, NY 14623
1-800-348-0033 or 716-272-0070

Come see us at ISA, October 17-20, 1988. Booth #2556.

ASYST is a trademark of Asyst Software Technologies, Inc.
©1988 Asyst Software Technologies, Inc.

Utilities So Good W

Go A Round With PC Tools™ Deluxe Version 5 For Just $25.



If you own any other utility package, the best way to convince you PC Tools Deluxe has more punch is to put them in the ring together. Which is why we're making this special offer.

Just mail us $25* and the original manual page 1 (or any other proof of purchase) from any version of Norton™ Utilities or Commander, Sidekick® or Sidekick Plus, X-TREE,™ Fastback,™ Disk Optimizer, or Mace™ Utilities, and we'll send you the complete PC Tools Deluxe Version 5 package.

Take a look at all our new features. **Even if you don't own one of our competitors' products, PC Tools Deluxe is still an exceptional buy at $79**–that's less than practically any one of these other products.

*Current registered customers can get an update for just $15.

Yes, show me the champ. Offer ends December 31, 1988.

☐ Here's $25 and proof of purchase of Norton Utilities or Commander, Sidekick or Sidekick Plus, X-TREE, Fastback, Disk Optimizer, or Mace Utilities.
☐ Here's $15 and the original page 1 from my PC Tools Deluxe manual to update to Version 5. (We'll send you a complete new manual.)

Name ______
Street Address ______
City ______ State ______ Zip ______
Phone ______
Computer Brand ______ Model ______

☐ Check enclosed ☐ Visa ☐ MasterCard
______
Exp. date ______
Signature ______

WE'VE MOVED! Mail to: Central Point Software, 15220 N. W. Greenbrier Parkway, #200, Beaverton, OR 97006 **503-690-8090**

PC Tools Deluxe is a trademark of Central Point Software, Inc. All other company and product names are trademarks of their respective companies or manufacturers

e’re Challenging The Competition.

NEW! Version 5

PC Tools Deluxe Version 5 Features:

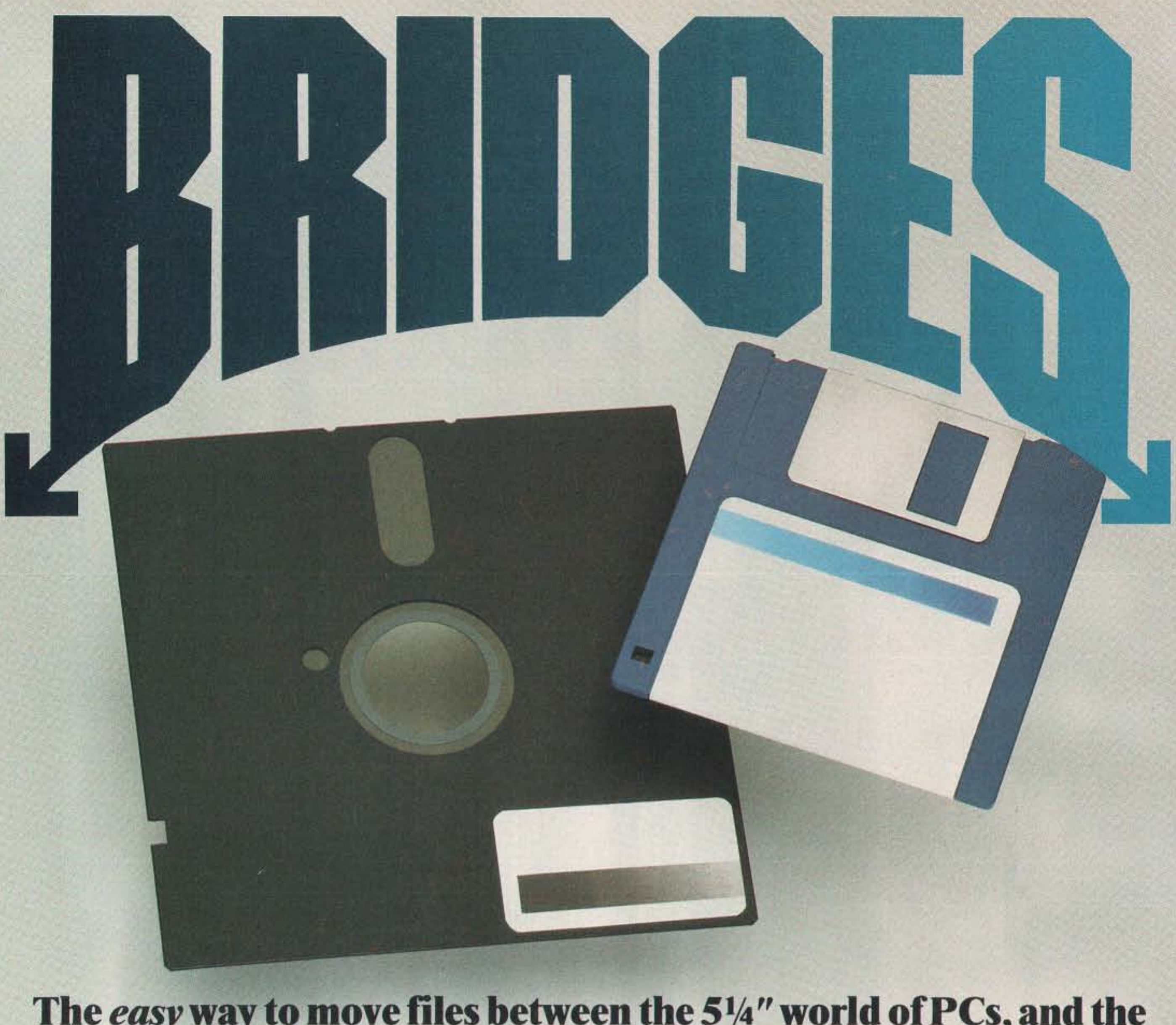
The best resident **DOS SHELL/ENHANCER** package anywhere with full mouse and color control, plus split screen/multiple directory and tree display ▪ Up to **15 RESIDENT NOTEPADS** with spell-checker and mail merge ▪ **OUTLINER** ▪ **APPOINTMENT SCHEDULER** ▪ **CLIPBOARD** ▪ Valuable **DATABASES**–including rolodex with autodialer ▪ Financial, algebraic and programmer’s **CALCULATORS** ▪ **MACRO-PROCESSOR** ▪ **BACKGROUND COMMUNICATIONS** ▪ **HARD DISK BACKUP** every bit as fast, reliable and feature-packed as Fastback Plus ▪ Super-fast **DISK OPTIMIZER** that dramatically improves hard disk performance ▪ The best file **UNDELETE** available for recovering data from even fragmented files ▪ Life-saving **UNFORMAT** for rescues from the ultimate disk disaster ▪ **A SAFE FORMAT** program for hard and floppy disks ▪ **FILE ENCRYPTION AND COMPRESSION** for the ultimate in data security and control ▪ And all this takes much **LESS RESIDENT MEMORY** than ever before.

If you’re using any other DOS utility, you can be sure of one thing. A knockout by PC Tools Deluxe in the first round.

Circle 42 on Reader Service Card

Central Point Software
INCORPORATED
15220 N.W. Greenbrier Parkway, #200
Beaverton, OR 97006
(503) 690-8090

PC Tools Deluxe.



The *easy* way to move files between the 5¼″ world of PCs, and the 3½″ world of PS/2s, Laptops, and 386s: Sysgen's Bridge family.

Because your PCs, PS/2s, 386 s and laptops all talk to different floppy disk sizes and formats, they can become frustrating *islands* of information.

For the simplest way to get files back and forth, just install Sysgen's Bridge products. Presto: Your different computers can talk to common diskettes.

Sysgen pioneered bridges. Now here are three ways to simplify your life in a multi-computer office.

Solution 1: Our Bridge-File 5.25 floppy disk drive.

A best seller, with over 50,000 installed. Attach it to your PS/2, and you can read and write files from PCs. Critics and users alike have raved about its small footprint, ease of use, and dual density capacity of 360Kb and 1.2Mb. (IBM's drive is twice the size, yet stores only one-fourth the data.)

Every PS/2 user deserves this easy connection to the world of PCs.

Solution 2: Our Bridge-File 3.5 floppy disk drive.

You get 720Kb *and* 1.44Mb capacities. Connect it to any PC, and you can read and write files from PS/2s, 386s, laptops, and other 3½″ machines.

Now all your PCs can share files with your newer systems.

And here's the ideal controller: The Omni-Bridge Controller.

Controls up to four drives, so you can mix and match 5¼″, 3½″, and floppy tape drives as you need. This hot card gives you big storage, plus twice the floppy disk and floppy tape transfer performance rates! At only $95, this is a winner.

Get your computers talking. Call the Sysgen Hotline for the name of your nearest dealer. 1-800-821-2151.

SYSGEN
INCORPORATED
556 Gibraltar Drive, Milpitas, CA 95035

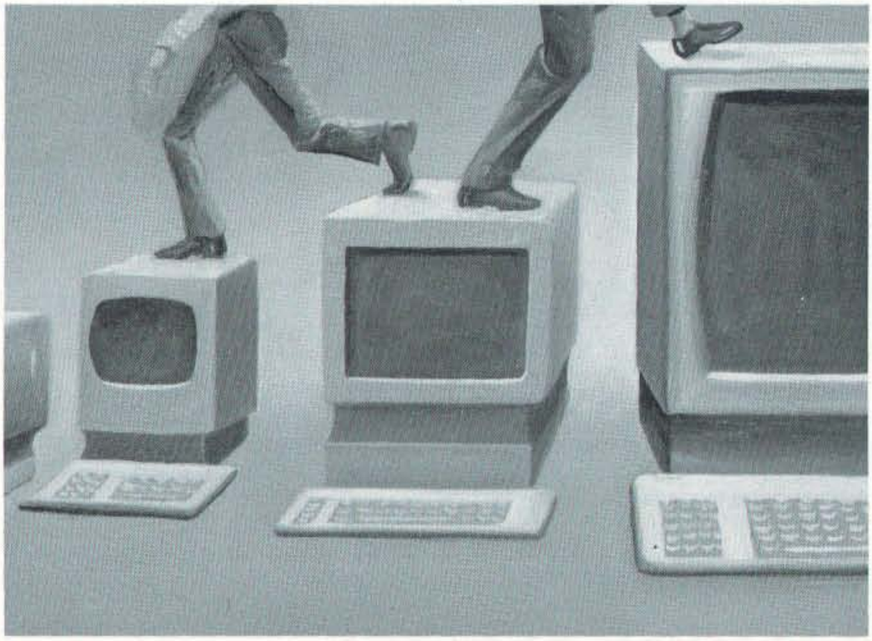
Trademarks: Sysgen, Bridge-File, Omni-Bridge—Sysgen Inc.; PS/2—International Business Machines Corporation.
Registered Trademark: IBM—International Business Machines Corporation.

Circle 218 on Reader Service Card

Wayne Rash Jr.

MIGRATING: UP OR DOWN?

Today's micros let you move some mainframe applications to your PC, but first you need to make some decisions



Conventional wisdom seems to be that during their lifetime, applications require a steady growth in the size and capacity of the computers on which they run. In other words, what starts out as a small, simple application written in something like dBASE eventually grows to require more and more computing power. This seems to be supported by the fact that users are getting bigger and bigger computers. If the computers are getting bigger, the applications must require bigger machines, right? Well, maybe not.

That's one of the problems with conventional wisdom. Many assumptions that become part of the culture don't really have a good reason to exist and are, in fact, invalid. Sure, you buy more computer capacity as time goes on. But that doesn't mean a particular application must necessarily grow through a series of incrementally larger machines until it's eventually on a mainframe. In fact, just the opposite may take place.

Part of the confusion is that there is an obvious drift among users to larger and faster machines. Where the IBM PC was once the standard in business, now it is the AT. Soon, machines based on the 80386 will be the norm. Does that mean that the individual applications demand larger machines? Let's take a look at the drift to larger machines, and then at the migration of applications.

Driving Forces for Migration

You may want to move to larger machines for a number of reasons. Not the least of these is the significant price reduction of the newer, faster machines. In addition, once you get used to having a computer, you want to do more with it, and you want to do things faster. This tendency, combined with the relatively low price of better machines, contributes greatly to user dissatisfaction with the status quo, and thus the urge to move up.

These same pressures have led software companies to write software that requires bigger machines. User demand for more features, combined with the availability of more powerful hardware, leads to software that is more capable but that also requires more in the way of resources. Where once programs worked well on computers that had only floppy disks, now some perform well only on hard disk machines.

Sadly, the user's desire for larger size is not due just to increased capability. To some extent, there is less incentive for software companies to spend the money to optimize their software for less-capable machines. Why bother, when nearly everybody has a hard disk drive and 640K bytes of memory?

All these factors, of course, give the impression that users want to migrate to larger machines. Whether there is a trend to a larger class of machines is another question. In many ways, a move from a microcomputer to a minicomputer or mainframe is a step backward.

One or Many Users?

To most users, a minicomputer or mainframe looks like a huge machine. When you visit a large computer room, you see row on row of CPU cabinets and more rows of disk drives. These appear to be large capable machines, and they are. That does not necessarily mean, however, that they will do more for your application.

Minicomputers and mainframes are designed to be shared by many users. For many applications, this is a primary ben-

continued

ILLUSTRATION: TRISH BURGIO © 1988

efit, but it may not be for you if you're the only one using the application. In fact, on a larger computer, you may have only a limited amount of CPU time and storage space. In addition, the fast response and sophisticated screens you are used to seeing on a microcomputer are unlikely to be available on the mainframe.

Almost everyone would agree that a mainframe computer is a powerful machine. But a mainframe or minicomputer has a different set of design criteria. It must deal concurrently with hundreds of users on a variety of terminals. Your microcomputer has to deal with just you.

Migrating Downward

One of the most overlooked paths of migration, and yet one of the most potentially rewarding, is movement from a large machine to a smaller one. This is especially so when moving from a mainframe or a minicomputer to a microcomputer. Oddly enough, this move is rarely considered. For some reason, whether it makes sense or not, applications that are on a mainframe tend to stay there.

I suppose that the size of the hardware and support staff has a lot to do with this situation. Users look at a room full of equipment and programmers and wonder how they could handle any application requiring such a large machine with the computers on their desks. Physical size, of course, really has little to do with capability.

At one time, mainframes actually had less capacity than today's microcomputers do. There was a time when 64K bytes of memory (core memory in those days) was a lot. Disk space was either unavailable or hideously expensive. You used cards to load programs and data. Many of the programs our businesses currently depend on were written in those days. Some of them have remained relatively unchanged, while others have been updated, but many are still essentially batch systems written in COBOL.

Of course, we have changed the way we use mainframe computers. Some of the most important changes have occurred because programmers have developed some impressive database management systems. A surprising number of old programs hailing from the IBM 360 days still reside on today's mainframes. We still use them, and they still take up space and soak up CPU cycles. These are the applications to look at for possible migration to a microcomputer.

The Micro Move

The same factors that have led users to move to more capable machines have also opened up the possibility of moving mainframe applications to microcomputers. The most notable of these factors are the ready availability of hard disk drives, the wide use of 80286 and 80386 processors, and operating systems such as OS/2 and Unix.

While mainframes and minicomputers once started out with no more memory and mass storage than many microcomputers, most of these old machines have been phased out. Likewise, as the machines in the mainframe and minicomputer worlds have become larger, the software has grown. Now, it isn't always possible to fit a really large COBOL application into 640K bytes.

Fitting an application into 16 megabytes on an IBM PC AT–compatible machine is not as much of a challenge, though. With versions of Unix becoming widely available for microcomputers, and with a wider variety of compilers becoming available for OS/2, software conversion is no longer outside the realm of the possible.

Despite the current lack of commercial applications for OS/2, this is one area where the move from the mainframe to the microcomputer is becoming possible. When the operating system was introduced, a number of compilers were introduced with it. Microsoft already publishes a version of the C compiler, and Micro Focus is shipping an ANSI-standard COBOL compiler. While it isn't yet possible to simply recompile a program to have it run under OS/2, that goal isn't so far away. Already, a number of large mainframe COBOL systems are being moved to microcomputers under OS/2.

Item Discussed

Micro Focus COBOL/2 Compiler
with animator $900
Micro Focus, Inc.
2465 East Bayshore Rd., Suite 400
Palo Alto, CA 94303
(415) 856-4161
Inquiry 955.

Factors to Help You Decide

So, you use a mainframe computer with several old COBOL programs. What's the best way to decide if they should be moved to a micro? Here are some ideas you should consider:

- Is yours essentially a single-user system? In other words, is it used by only one person at a time? Many older applications are limited to a single user, even though the computer they run on can handle hundreds.
- Are you having problems with response time? Because they are required to service hundreds of users, mainframes can sometimes keep you waiting. Often a microcomputer will be faster, mainly because there's only one user.
- Are you getting ready to perform a major rewrite? Major new development efforts on a mainframe can take years. If you really need it now, maybe a microcomputer is the only way it will happen.
- Is the application written in something standard? While most mainframe business applications are written in COBOL, FORTRAN, or another common language, many of these languages have no practical counterpart in the microcomputer world. This situation could be a showstopper, unless you're planning on doing a complete rewrite, in which case it wouldn't matter so much.
- Is the mainframe running out of space? It costs a lot less to buy a microcomputer than to upgrade a mainframe. Maybe there are programs that could migrate, given a reasonable level of effort.

There are as many reasons to migrate to microcomputers as there are individual circumstances. Likewise, there are any number of reasons not to move. The important thing to remember, however, is that sometimes you can move. Today's 80286- and 80386-driven personal computers will let you put a mainframe application on your desk.

Now on BIX

I've been granted my own BIX conference in which to conduct ongoing conversations about the subjects discussed in this column. I'd love to hear from you. Please feel free to join the conference (it's called "to.wayne") and ask questions, grind axes, or air your opinions. Fair warning: Contributing to BIX is akin to writing a letter to the editor, and I may quote you sometime. ■

Wayne Rash Jr. is a member of the professional staff of American Management Systems, Inc. (Arlington, Virginia), where he consults with the federal government on microcomputers. You can reach him on BIX as "waynerash."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Fast VGA *Genoa* VGA

MATCH THE LEADER in super VGA Resolution

- ☑ **Twice as Fast RAMBIOS™ (PC Labs Benchmark test).**
- ☑ **Register level VGA, MCGA, EGA, CGA, MDA & Hercules.**
- ☑ **IBM Feature Connector for Video Add-Ons.**
- ☑ **Full IBM 8514 Display Support (1024 x 768, 16 colors).**
- ☑ **Full MultiSync Display Support (800 x 600, 16 colors).**
- ☑ **Both TTL and Analog Display Support.**
- ☑ **512 x 512 and 640 x 480 with 256 Colors.**
- ☑ **All the best drivers, including AutoShade.**
- ☑ **VGA setup and diagnostic utility.**

Get the highest VGA performance at the best price, in true Genoa tradition.

For more information on Genoa SuperVGA products,
contact Geri Scheer at:
Genoa Systems Corporation
75 East Trimble Road • San Jose, CA 95131 U.S.A.
Tel: 408-432-9090 FAX: 408-434-0997 TELEX 172319

Genoa
SYSTEMS CORPORATION

Genoa Systems (U.K.) Limited, Telephone 44-01-225 3247
Genoa International Ltd, Taiwan Branch, Telephone: 886-02-776 3933

® 1988, Genoa Systems Corporation, SuperVGA is a trademark of Genoa Systems Corporation. AutoShade is a trademark of AutoDesk Corporation, MultiSync is a trademark of NEC HM Electronics.

KEYBOARD

You Can Never Be Too Powerful Or Too Thin.

As portable PCs go, ours may look a bit on the skinny side. But they're by no means undernourished.

After all, each 286 and 386 microprocessor-powered Toshiba portable has an easy-to-read gas plasma screen. Each is IBM-compatible. And each gives you a wide range of features you'd expect only from a desktop PC.

The T3100/20, for example, weighs a scant 15 pounds, yet has an abundance of power. It comes with a 286 microprocessor and 640KB of RAM that's extendable to 2.6MB. Plus, there's a built-in 20MB hard disk.

Our T3200 has the advantages of a 12MHz 286 microprocessor, an EGA display system, a 40MB hard disk and 1MB of RAM expandable to 4MB. Also, its two IBM-compatible internal expansion slots let you connect your PC to mainframes, LANs and more. But what's even more impressive is how we managed to fit all this into a slim, 19-pound package.

Then there's our T5100. As amazing as it seems, we managed to squeeze a 16MHz Intel® 386 microprocessor into a slim package that weighs less than 15 pounds. To that we added an EGA display system and a 29 msec 40MB hard disk. As your thirst for power grows, its 2MB RAM can be upgraded to 4MB. Plus, you'll receive Microsoft's® Windows/386 at no charge with your T5100 purchase.

For more information on Toshiba computers and printers, call 1-800-457-7777. And rest assured that whichever Toshiba PC you choose, you'll be getting the kind of power once reserved for cumbersome desktop computers.

All of which proves you can maintain a position of great power without having to throw a lot of weight around.

Toshiba PCs are backed by the Exceptional Care program (no-cost enrollment required). See your dealer for details. IBM is a registered trademark of International Business Machines Corp. Intel is a registered trademark of Intel Corp. Microsoft is a registered trademark of Microsoft Corp.

In Touch with Tomorrow

TOSHIBA

Toshiba America Inc., Information Systems Division

Circle 240 on Reader Service Card (DEALERS: 241)

Get your work done before 1991.2

The future of personal computing is clear. More powerful PCs. Easier to use PCs. With graphics and character-based programs working side by side. Talking to each other. Multitasking. Windowing. Menuing. Mousing. Getting your work done easier and faster.

Have it all now.

DESQview™ is the operating environment that gives DOS the capabilities of OS/2.™ And it lets you, with your trusty 8088, 8086, 80286, or 80386 PC, leap to the productivity of the next generation. For not much money. And without throwing out your favorite software.

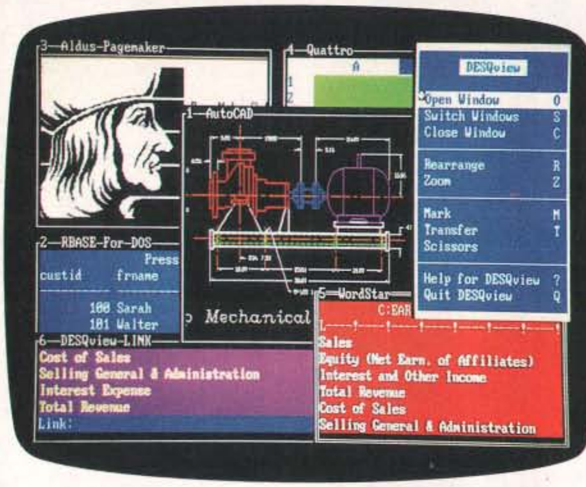
Add DESQview to your PC and it quickly finds your programs and lists them on menus. So you can just point to the program, using keyboard or mouse, to start it up. DESQview knows where that program lives. And what command loads it.

For those who have trouble remembering DOS commands, it adds menus to DOS. It even lets you sort your files and mark specific files to be copied, backed-up, or deleted—all without having to leave the program you're in.

Best of all, DESQview accomplishes all this with a substantial speed advantage over any alternative environment.

Multitask beyond 640K.

When you want to use several programs together, you don't have to leave your current program. Just open the next program. View your programs in windows or full screen. Open more programs than you have memory for. And multitask them. In 640K. Or if you own a special EMS 4.0 or EEMS memory board, or a 386 PC, DESQview lets you break through the DOS 640K barrier for multitasking. You can start 1-2-3 calculating and tell Paradox to print mailing labels while you're writing a report in Word Perfect, or laying out a newsletter in Ventura Publisher, or designing a building in AutoCAD.



For programmers, DESQview's API, with its strengths in intertask communications and multitasking, brings a quick and easy way to adapt to the future. With the API's mailboxes and shared programs, programmers are able to design programs running on DOS with capabilities like those of OS/2.

DESQview even lets you transfer text, numbers, and fields of information between programs.

Fulfill the 386 promise.

For 80836 PC users, DESQview becomes a 386 control program when used in conjunction with Quarterdeck's Expanded Memory Manager (QEMM)-386—giving faster multitasking as well as virtual windowing support.

And when you use DESQview on an IBM PS/2™ Model 50 or 60 with QEMM-50/60 and the IBM Memory Expansion Option, DESQview gives you multitasking beyond 640K.

Experts are voting for DESQview. And over a million users, too.

If all of this sounds like promises you've been hearing for future systems, then you can understand why over a million users have chosen DESQview. And why *PC Magazine* gave DESQview its Editor's Choice Award for "The Best Alternative to OS/2," why readers of *InfoWorld* twice voted DESQview "Product of the Year" why, by popular vote at Comdex Fall for the last two years in a row, DESQview was selected as "Best PC Environment" in *PC Tech Journal's* Systems Builder Contest.

PC
MAGAZINE
EDITOR'S
CHOICE
NOV. 24, 1987

INFO WORLD 1986 AND 1987
PRODUCT OF THE YEAR

DESQview lets you have it all now.

DESQVIEW SYSTEM REQUIREMENTS:
IBM Personal Computer and 100% compatibles (with 8086, 8088, 80286, or 80386 processors) with monochrome or color display; IBM Personal System/2• Memory: 640K recommended; for DESQview itself 0-145K• Expanded Memory (Optional): expanded memory boards compatible with the Intel AboveBoard; enhanced expanded memory boards compatible with the AST RAMpage; EMS 4.0 expanded memory boards•Disk: two diskette drives or one diskette drive and a hard disk•Graphics Card (Optional): Hercules, IBM Color/Graphics (CGA). IBM Enhanced Graphics (EGA), IBM Personal System/2 Advanced Graphics (VGA)• Mouse (Optional): Mouse Systems, Microsoft and compatibles• Modem for Auto-Dialer (Optional): Hayes or compatible• Operating System: PC-DOS 2.0-3.3; MS-DOS 2.0-3.2• Software: Most PC-DOS and MS-DOS application programs; programs specific to Microsoft Windows 1.03-2.03, GEM 1.1-3.0, IBM TopView 1.1• Media: DESQview 2.0 is available on either 5-1/4" or 3-1/2" floppy diskette.

YES! I need increased productivity now!

Qty	Product	Format	Price Each	Totals
	DESQview 2.0	☐5-1/4 ☐3-1/2	$129.95	
	QEMM-386	☐5-1/4 ☐3-1/2	$59.95	
	QEMM-50/60	☐5-1/4 ☐3-1/2	$59.95	
	Shipping & Handling	$5 in USA/ $10 outside USA		
		Calif Residents add 6.5%		
			Grand Total	

Name ______

Address ______

City ______ State ____ Zip ______

Payment Method ☐ Visa ☐ MasterCard Expiration ____/____

Account # ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Quarterdeck
150 Pico Boulevard, Santa Monica, CA 90405
(213) 392-9851

Trademarks are property of their respective holders: IBM, OS/2, PS/2, 1-2-3, Paradox, Word Perfect, Ventura Publisher, AutoCAD, Intel, Above Board, AST, RAMpage, Advantage, Hercules, Mouse Systems, Hayes, Microsoft, Windows, TopView.

Circle 183 on Reader Service Card (DEALERS: 184)

Mark Minasi

OS/2 DREAMS

I've got a few suggestions for the operating system that would be—could be—king

OS/2 has some neat features. And by the time you read this, IBM and Microsoft will have released the Presentation Manager, filling out OS/2 considerably. (I hope for your sake that they fixed it before they shipped it. The beta developer's version is very unstable.)

But OS/2 has some really fatal flaws. I'm not just talking about bugs here: Yes, OS/2 is buggy, but so is version 1.0 of any product. I'm talking about genuine design flaws.

OS/2 is important to IBM and Microsoft. It's either the operating system that will take us into the twenty-first century, or the operating system that will take Microsoft into Chapter 11. So I hope they'll fix these things.

Support the 80386, Not the 80286

OS/2 was written for the 80286 rather than the 80386 because the project first got under way in 1984, shortly before the announcement of the IBM PC AT. At that time, there *was* no 80386. For those of you with an 80286-based system, help is now available via the 80386SX, a chip that makes 80386 upgrades less expensive for 80286 owners.

Despite the larger base of 80286 machines than 80386 machines, there are several compelling reasons to bypass the 80286 altogether and release future versions of OS/2 to exploit 80386 features.

First, programmers would gain access to the 80386 protected mode, which is much more useful than the 80286 protected mode. (The 80386 chip can also run the 80286 mode, which is why it can run OS/2 now.) Intel chips address memory in a two-part manner: *segment* and *offset*. Think of the segment as the neighborhood and the offset as a particular street address within the neighborhood.

The 80286 protected mode won't allow a segment larger than 64K bytes. The effect of this on 80286 programs (and, it follows, OS/2 programs) is to impose a "nuisance barrier" of 64K bytes. Data structures or programs larger than 64K bytes require special handling, so many software vendors have not offered large program or data capabilities.

The 80386 has a protected mode that allows segments to be as large as 4 gigabytes. All the existing code written for mainframes and minicomputers—programs written in an environment without the 64K-byte shackles—could be more easily ported to machines running an 80386-based OS/2. Large segments would also help make converting code from the Motorola 680x0 family easier.

A second argument for the 80386 is mode switching. Recall that OS/2 operates in protected mode. DOS operates in real mode. An 80286 powers up in real mode. When OS/2 boots up, it switches the 80286 to protected mode. OS/2's compatibility box, as it runs DOS programs, must operate in real mode. The problem is that there is a command to switch the 80286 from real mode to protected mode, *but none to reverse the process*. How, then, does OS/2 switch to real mode to run the compatibility box?

Believe it or not, it resets the processor—reboots the system, in effect. Since the processor is reinitialized when in real mode, the compatibility box can run. The downside is that the 80286 is then deaf to external interrupts (e.g., communications and keyboard) for 30 milliseconds. The 80386 improves matters: Intel included a command to switch the 80386 from protected mode to real mode without going through the reboot sequence.

continued

ILLUSTRATION: MARK HAMPSTEAD © 1988

Circle 63 on Reader Service Card (DEALERS: 64)

Use it or lose it!

Use DataSaver

standby uninterruptible power supply, and protect your microcomputer against costly data loss and hardware damage.

- Constant AC line protection against power disturbances and interruptions.
- Built-in spike/transient suppression and EMI noise filtering.
- Powerful sizes to protect any system from the earliest Apples to the latest PS/2's. International models, also.

For more information, call:
TOLL-FREE 800/332-3440.
In California, call 805/541-4160.
Or write to us at the address below.
GSA No. GS 00K-87-AGS5393 PS01
Dealer/VAR inquiries invited

Cuesta Systems Corporation
3440 Roberto Court
San Luis Obispo, CA 93401

This results in no dropped interrupts.

A third reason to build OS/2 for the 80386 is that the 80386 has a "DOS multitasking" mode, called the Virtual 8086 (V86) mode. In previous columns, I have discussed that, due to the way DOS programs are written, there's no way to write a bulletproof multitasking version of DOS for the 8088, 8086, or 80286. But the 80386's V86 mode provides the hardware support to make DOS multitasking possible. Products like IGC's VM/386 and Microsoft Windows/386 use V86 mode (see "Life After DOS" by Namir Clement Shammas on page 142). Had OS/2 been written for the 80386, DOS multitasking could have been accomplished. V86 is designed to coexist with protected mode, so it would be easy to support multiple compatibility boxes.

Bring Back the DOS Amenities

DOS, at about $100, includes a language interpreter (BASICA), a debugger/assembler (DEBUG), and an ASCII text editor (EDLIN). Microsoft Windows, at $99, includes a terminal emulator, notepad, word processor, paint program, calculator, analog clock, and reversi game.

OS/2 and the Presentation Manager provide none of these. Bring the goodies back.

Make It Less Expensive

At $325, OS/2 is over three times the price of DOS. But that's not all. The real costs of OS/2 are memory and video. The Presentation Manager takes up 2.6 megabytes of RAM just to boot up. As OS/2's disk performance is abysmal without a cache, you're forced to add more memory to accommodate a 1- to 2-megabyte cache (2 megabytes is significantly better than 1 megabyte). OS/2 is really most comfortable in a machine with 5 to 8 megabytes of RAM. To run the Presentation Manager, you'll need an EGA or VGA and a monitor. The Hercules board isn't supported by OS/2.

A megabyte costs about $400, so you're looking at $1600 to $2800 to add 4 to 7 megabytes. That's a lot of money to spend on each workstation. By comparison, VM/386 and DESQview can run on any kind of video board, require only 640K bytes of RAM (although, obviously, more memory is better), and cost $125 to $245, depending on the product and options.

Add DOS Multitasking Support via V86 Mode

I said this above under the 80286/80386 discussion, but there's an important point to make here. IBM and Microsoft misled us to believe that DOS 5.0 would be a multitasking DOS (i.e., it would run multiple existing DOS applications). Had we known in 1985 that we'd have to wait 3 years for a new, incompatible operating system requiring all software to be rewritten, we'd have gone to Unix and gotten it all over with quickly.

End Software Defenestration

"Defenestration" means to be forced through a window. Microsoft seems to want to force us to buy into Windows for everything. More and more of its DOS products need Windows. To get V86 multitasking (Windows/386), you have to buy into the Windows interface.

Perhaps the worst example of this is the Presentation Manager, which is really "Windows for OS/2." The Presentation Manager offers some really slick device-independent graphics routines to programmers. They are called GPI, which stands for graphic application program interface. Rather than writing a routine to draw a circle on the screen, the programmer need only invoke a GPI call, without worrying about what kind of video board the program will run on. The problem: Your program must run under the Presentation Manager to use GPI calls.

This wasn't necessary. Microsoft is just committed to the Windows interface, and GPI is enough bait to convince many developers to swallow the interface. GPI should be available in the text-based OS/2 interface also.

Support Disks Larger than 32 Megabytes

We have seen that disk I/O is considerably slower under OS/2 than under DOS. This is, I hope, only a temporary problem. But the 32-megabyte limitation is still with us. Why? MS-DOS 3.3 and PC-DOS 4.0 eliminate the 32-megabyte limitation on hard disk size, upping the maximum to 512 megabytes.

Why not OS/2? Microsoft talks about a new, incompatible, "protected" file system for OS/2 2.0. I remember how much fun it was convincing DOS 1.1 programs to read data in DOS 2.0 subdirectories. Keep the new file structure, guys, and just increase the disk size.

Offer a Text Mode Presentation Manager

Video boards often have two modes: text and graphics. In text mode, the screen can show only text—no graphics. It's a little limited, but it's faster than graphics mode. Graphics mode can display graph-

continued

Five easy ways to boost your BASIC

ProBas™
Professional Basic Programming Library

ProBas is a library of 232 routines that kicks BASCOM and QuickBASIC into 5th gear and gives you powers and abilities far beyond those of mortal men. So much for the hype, now down to brass tacks:

- **600 page 3-part manual**
- **Full-featured windowing**
- **Screen snapshots**
- **Virtual screens in memory**
- **Lightning-fast file I/O**
- **Full mouse support**

Plus over 200 essential services from directory and equipment routines to handy string, date, time, and input routines. For all versions of QuickBASIC and BASCOM including BASCOM 6.0 for OS/2. **Just $99.00!**

ProBas™ ToolKit

The **ToolKit** is a collection of assembly and BASIC modules that use the **ProBas** library to save you even more hours of grunt work. Why spend hundreds of hours re-inventing the wheel when you can just plug in **ToolKit** modules like:

- **Menu Generators**
- **Fast B-tree indexing**
- **Mini-editor with word-wrap**
- **Patch .EXE files**
- **Protected storage areas**
- **Julian date routines**

Plus clock, calendar, BCD math routines, and much more. Complete with BASIC source code and comprehensive manual. The **ProBas** adds capabilities and helps conserve your most valuable asset of all, time! Requires **ProBas**. **Just $99.00!**

ProBas™ TeleCommToolKit

The **ProBas TeleComm ToolKit** is a collection of high-level communications modules that you plug into your code to provide popular file transfer protocols, terminal emulations, login scripts and baud rates up to 57,600 bps. You get:

- **Xmodem/Modem7/Xmodem-1k**
- **Ymodem (single and batch)**
- **CRC-16 and Checksum**
- **VT52, VT100, ANSI BBS etc.**
- **Auto Dialer & data base**
- **Documented BASIC source**

Why use clumsy SHELLs to complex terminal programs when you can plug just the communications routines you need into your code? Implement just the features, and commands you want. Requires **ProBas**. **Just $75.00!**

ProRef™
On-Line Help For ProBas

ProRef is a pop-up help system for the 232 routines in **ProBas**, pop-up help for your routines, and an extension of the QuickBASIC programming environment. See the calling syntax and help for any **ProBas** routine, or any of your routines, with just a few keystrokes or mouse clicks. Pop-up and ASCII chart, calculator, keyboard scan code module or almost any DOS program via hot-key. **Just $50.00!**

ProScreen™
Professional Screen Management System

ProScreen is a full-featured screen generator/editor that will save you more design and coding time than you ever thought possible. **ProScreen** works with screens like a word processor works with text to provide complete control over screen characters, placement and colors. **ProScreen** comes with subroutine source, extensive on-line help and a 285 page manual with tutorial and reference. **Just $99.00!**

Our thirty day, money-back guarantee assures you the highest quality and our technical support staff is always ready to help. Try our BBS at **(301) 953-7738** or give us a call at:

HAMMERLY
COMPUTER SERVICES, INC.

8008 SANDY SPRING ROAD • LAUREL, MD 20707

(301) 953-2191

Add $3.00 per item ($7.00 Canada) for shipping. Trademarks ProBas, ProRef, ProScreen: Hammerly Computer Services, Inc. QuickBASIC, BASCOM: Microsoft Corp.

Circle 101 on Reader Service Card

ics *and* text, but writing text is much slower in graphics mode.

Graphics mode is, then, more flexible than text mode but slower. The Presentation Manager operates *solely* in graphics mode. Software running in a window under the Presentation Manager always runs in graphics mode—even software originally written to operate in text mode. This means that a text application will run much more slowly under the Presentation Manager, as the screen I/O will be slowed down considerably. For example, I recently TYPEd a file to the screen 20 times, first in OS/2 text mode and then in a Presentation Manager window. The operation took 97 seconds in text mode and 298 seconds in a Presentation Manager window.

Most existing DOS applications are text mode only. It makes no sense to force existing applications to fit the graphics mold of the Presentation Manager. Why not offer a version of the Presentation Manager that does windowing in *text* mode? DESQview does this successfully already.

Provide a System Monitor Screen

Multitaskers usually have some way of monitoring and adjusting system performance. In VM/386, for example, a virtual machine manager lets you adjust priorities, assign devices to virtual machines, and the like. OS/2 has nothing like that. Instead, it requires a program that would (at a minimum) display active jobs, allow termination of a crashed job, and display and allow adjustment of job priorities.

Along these lines, I'm always a little worried by OS/2's reboot command. To reboot the system, you use the familiar Ctrl-Alt-Del combination. But, recall, you could have 10 jobs running simultaneously. OS/2 doesn't say "Are you sure?" or anything of the like. It doesn't inform you what files are open at the moment. It just reboots.

Open Up the Serial Ports

OS/2 supports nongraphics text-based applications through its VIO (video I/O) routines. These are a basic set of simple, nongraphics, teletypewriter-like system functions. Recall that OS/2 programs can't talk directly to the screen. They *must* use OS/2 to send output to the screen. Given that, it would be simple to offer an option whereby any OS/2 program's screen output and keyboard input could be redirected to the serial port. DOS tried this with the `CTTY` command, but so many DOS programs bypassed DOS for I/O that the command wasn't worth much.

This feature would allow simple remote access to your PC from the road via modem and easier remote software support from software vendors. It also would pave the way for multiuser capabilities.

Call Me a Dreamer

Don't get me wrong. In many ways, OS/2 is a really nice system. Microsoft and IBM have made a great first step. But I hope they take it further.

Are you listening, folks? ■

Mark Minasi is a managing partner at Moulton, Minasi & Company, a Columbia, Maryland, firm specializing in technical seminars. He can be reached on BIX as "mjminasi."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

SUNDAY 10-5
PROMPT DELIVERY
GUARANTEED LOWEST PRICES
TOLL FREE OUT OF N.Y.: 1-800-874-1235
IN N.Y.S. (800) 223-6779 — N.Y.C. (212) 463-8330 — 7 Days A Week
FAX # 212-463-8335
S & W COMPUTERS & ELECTRONICS
31 West 21 Street, New York, N.Y. 10010
HOURS: Sun. 10-5, Mon.-Thurs. 9-6, Fri. 9-2, Sat. Closed • Credit cards charged at time of order. M.C., VISA, C.O.D. Qty. limited • Not responsible for type errors. Prices subject to change without notice. Prices are for consumers. Returns w/our written authorization
ALL MERCHANDISE SHIPPED IN FACTORY SEALED CARTONS, 100% GUARANTEED

Circle 206 on Reader Service Card

The 3.5" Migration.

As though by the force of nature, computer users are flocking to the new 3.5″ standard.

A Clear Flight: A top-quality 3.5″ drive allows direct access between older and newer systems, between IBM PC/XT/AT, compatibles and PS/2 systems, and between home office desktops and laptops in the field. And most experts agree that it's better to upgrade an older system with a 3.5″ floppy drive than to downgrade a new system with an old-technology drive.

A Third First: Manzana introduced the industry's first 3.5″ upgrade in 1985, and the first 1.44MB drive in 1987. Today, Manzana introduces the 3rd Internal™ drive, for those with room for more than two.

Maximum Versatility: Manzana offers several drive configurations, including an internal, a host-powered external, and a self-powered external. All systems come with Manzana's own 3Five® software, which runs with MS-DOS version 2.0 or higher, to read, write and format disks at 1.44MB, 720K, and non-standard MS-DOS formats, including HP 150 and 110.

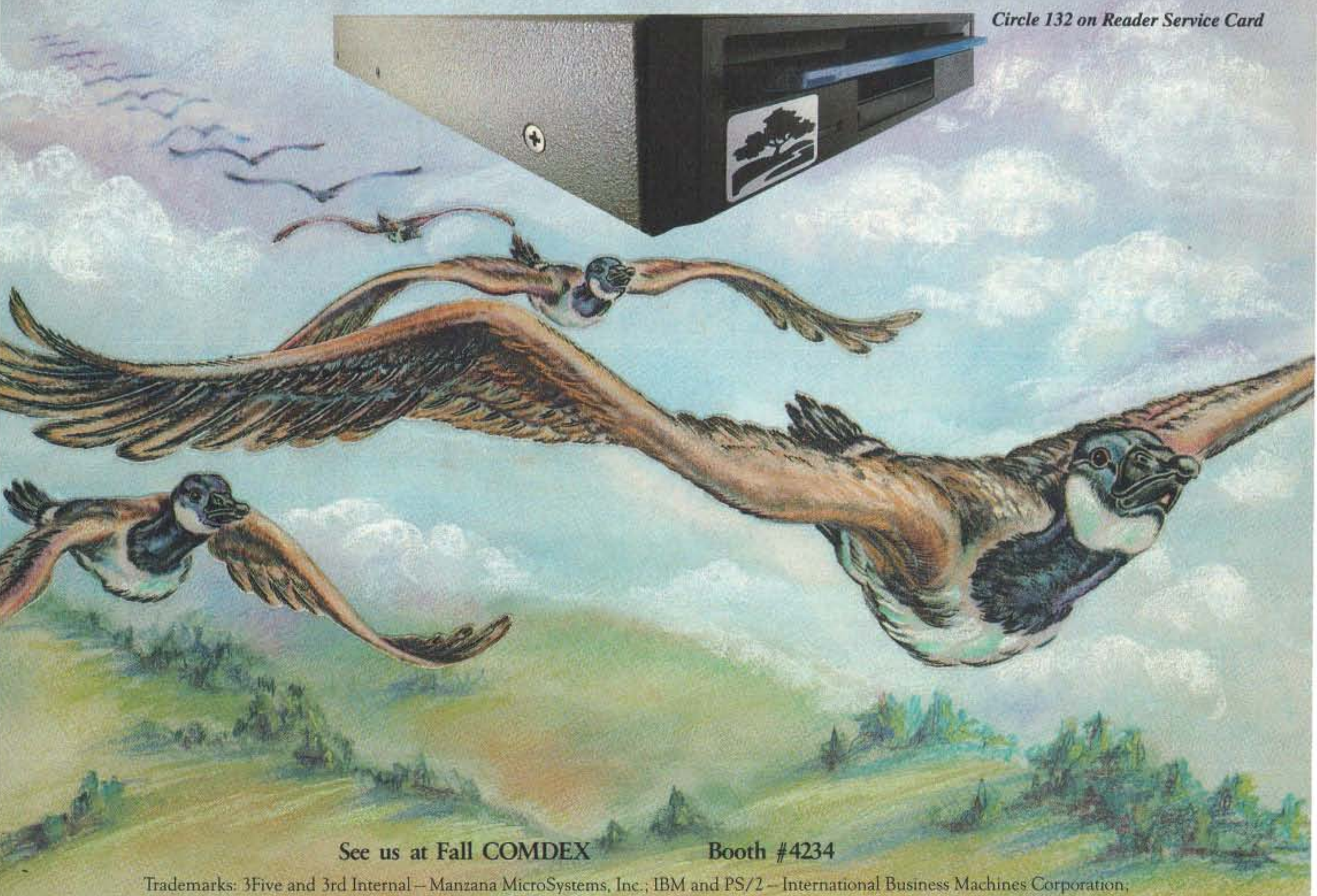
For Fast Information: See us at major shows. Or call 805/968-1387, FAX 805/968-5449, TELEX 4932215 or write for the whole story on The 3.5″ Migration, and literature on the full line of Manzana drives: Manzana MicroSystems, Inc., P.O. Box 2117, Goleta, CA 93118.

Soon you'll be heading in the right direction from instinct alone.

TM

Manzana drives it home.

Circle 132 on Reader Service Card



See us at Fall COMDEX Booth #4234

Trademarks: 3Five and 3rd Internal – Manzana MicroSystems, Inc.; IBM and PS/2 – International Business Machines Corporation; MS-DOS – Microsoft, Inc.; HP – Hewlett Packard Corporation; ©1988, Manzana MicroSystems, Inc.

The difference

Now there's a software system that makes it easy for users to take on their most ferocious office data problems.

We call it SmartWare. You'll call it the friendliest software ever.

Between Applications

Smart includes the full range of office productivity applications: word processing, data base management, spreadsheet analysis, business graphics and communications.

A Product of
INFORMIX
Software

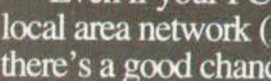
All perfectly integrated for easy transfer of data from one application to the next.

And only Smart lets you create custom programs that actually jump between applications. For instance, a single keystroke can transform a worksheet into a 3-D pie chart, paste the chart into a document, and send the document via modem to the home office.

Between Workgroups

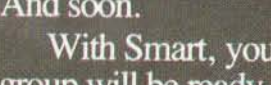
Even if your PC isn't on a local area network (LAN) now, there's a good chance it will be. And soon.

With Smart, your entire workgroup will be ready.



Remember

Smart's "REMEMBER" command lets non-programmers create custom programs.



r Send T

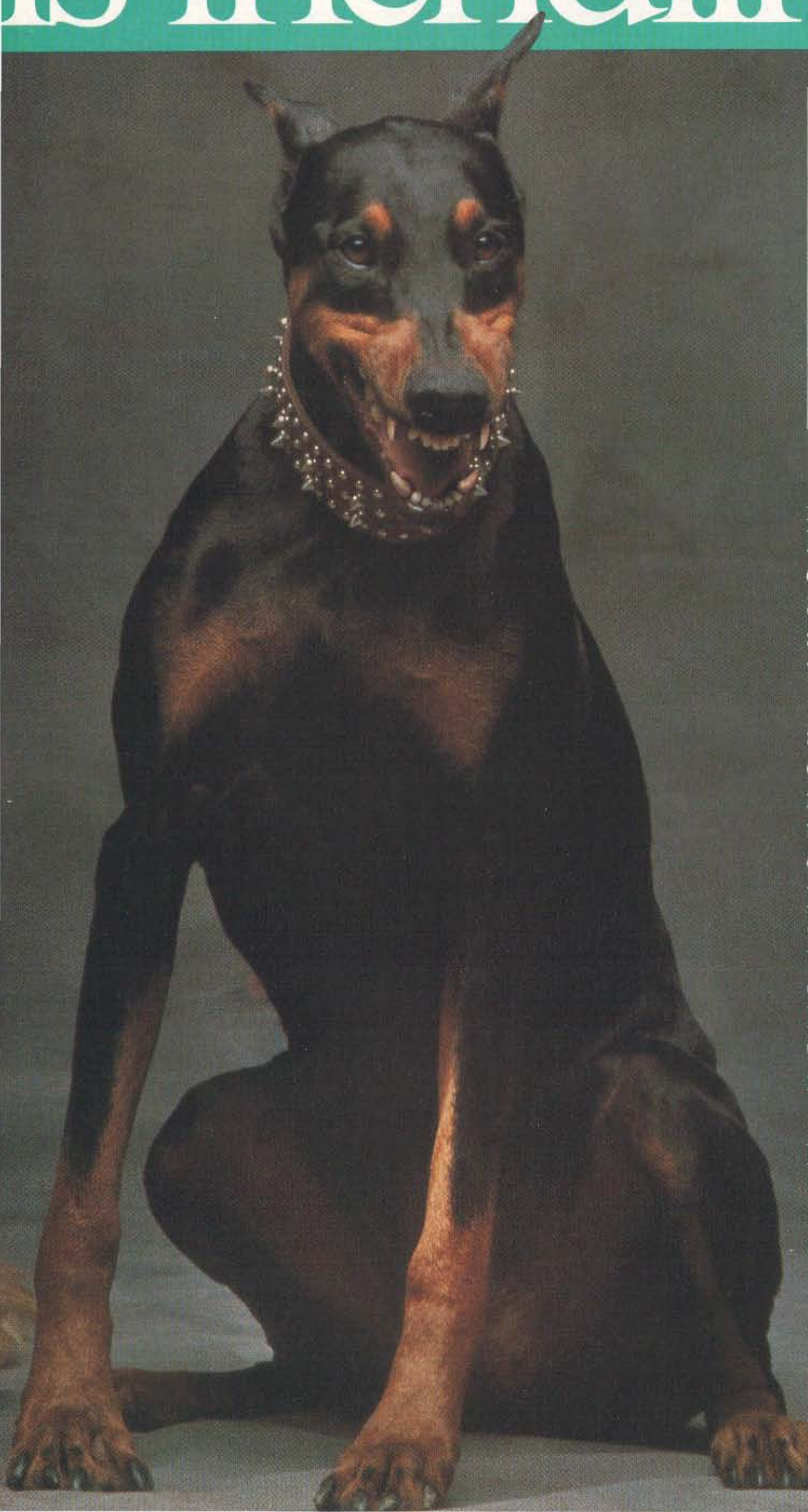
Smart's "SEND" command makes it easy to move data between applications.

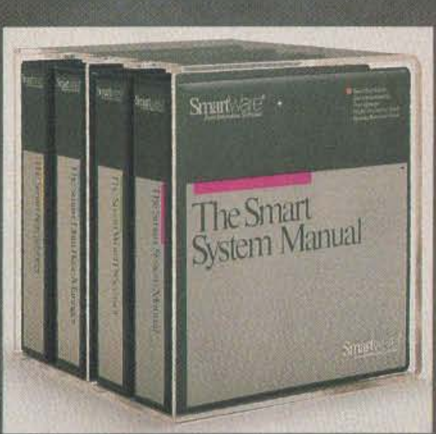
Waiting for record l

Smart automatically protects your data in multiuser environments.

© 1988, Informix Software, Inc. SmartWare, Unix and Xenix are registered trademarks of Informix Software, AT&T and Microsoft respectively.

is friendliness.





Every Smart application includes fully automatic File or Record-Locking for shared data. So, right out of the box, Smart can be used either on a single user PC or on a LAN workstation.

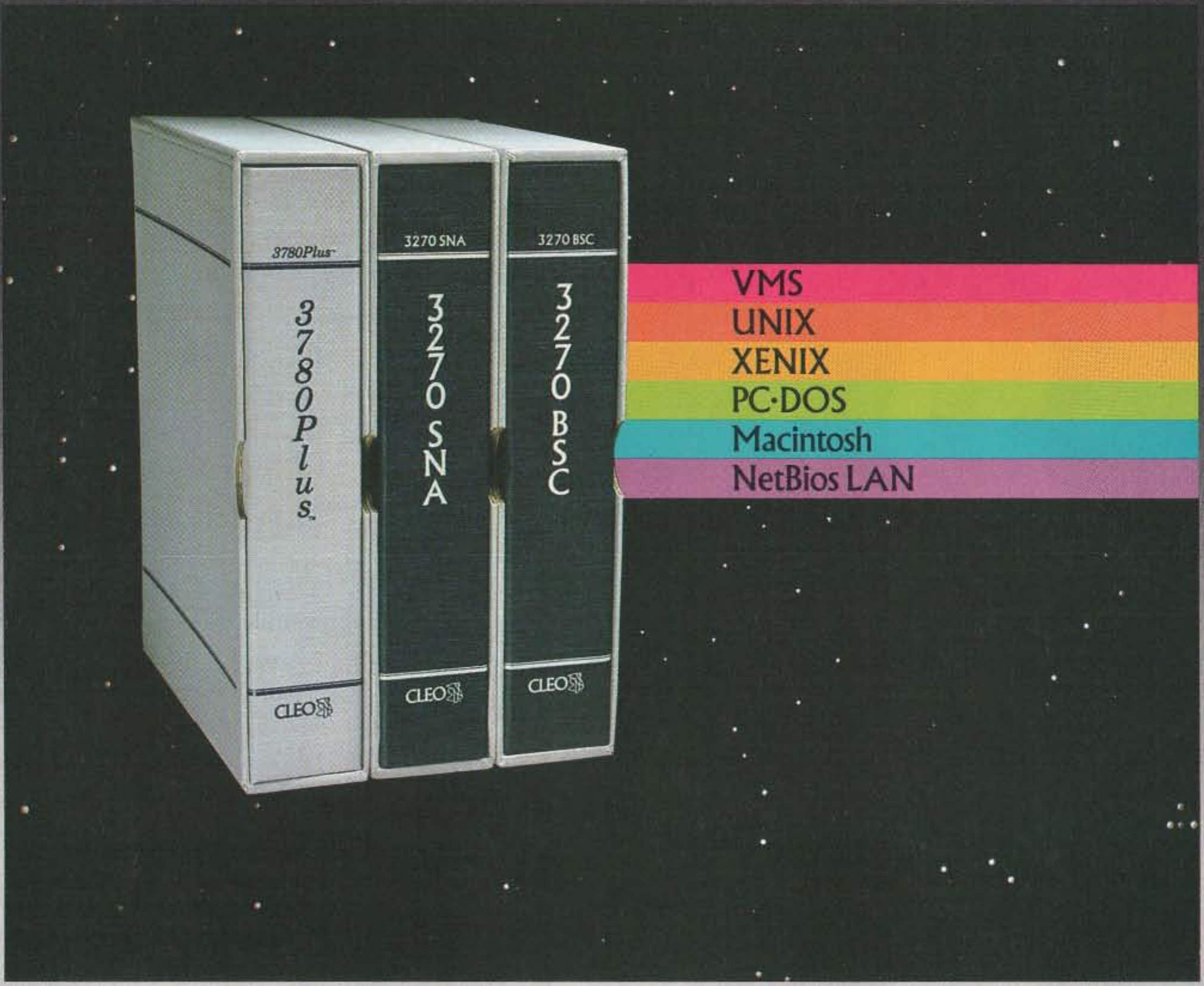
Whether you're just getting started as a lone computer user, or you're the Manager of Information Systems supporting thousands of PC users, discover easy-to-use applications your office won't outgrow. Single user and Multi-user software for DOS, LANs, UNIX or XENIX systems: Word Processing, Spreadsheet & Graphics, Database Management and Communications.

For additional information, plus a Free Smart Demo Disk, return the reply card or call toll-free (800) 331-1763. In Kansas or Alaska call (913) 492-3800, in Canada call (800) 233-6905.

Circle 112 on Reader Service Card

SmartWare®

CLEO is your SNA, BSC and Coax Gateway



Sharing Information

Whatever your industry, your computers need to share information with your mainframe. Or, they need to exchange data with other computers. In either case, you need a total communications solution. You need software, hardware interfaces and modems that all work together smoothly. You need CLEO!

CLEO software products allow your computer to communicate with minicomputers and mainframes, and to emulate their workstations. Since 1981, CLEO has provided communications between micros, minis, and mainframes for the automotive, insurance, medical and banking industries. Today over 78,000 CLEO users worldwide are running on all major computer brands. The greatest number of these users run CLEO software on IBM Personal Computers and NETBIOS LANs.

Circle 45 on Reader Service Card

Complete Software/Hardware Package

Every CLEO package contains all the software and hardware accessories you'll need. Your selected CLEO SNA, BSC, or Coax software is packaged with 1) an internal modem card for dial-up applications, or 2) an interface card and cable for use with your existing modem, or 3) a Coax card for local connectivity. There's no waiting for non-CLEO add-ons. And, you get prompt, single-source service.

Package prices range from $795.00 for most stand-alone packages, up to $1,995.00 for the 32-user SNA gateway.

Call us today to discuss your application.

CLEO Software
1639 North Alpine Rd.
Rockford, IL 61107
Telex 703639
FAX 815/397-6535

Headquarters:
USA: **1-800/233-2536**
Illinois: 1-800/422-2536
International: 815/397-8110

Sales and Distribution:
Benelux: 31 (0) 33-948888
Canada, East: 800/361-3185
Canada, West: 800/361-1210
Canada, Montreal: 514/737-3631
Colombia, S.A.: 12172266
Denmark: 02 94 81 19
England: (0993) 776543
France: 146861136
Italy: (0331) 634 562
Mexico City: 596-5539
Sweden: 468311780

CLEO®

CLEO and 3780Plus are registered trademarks of CLEO Software. IBM is a registered trademark of International Business Machines Corporation.

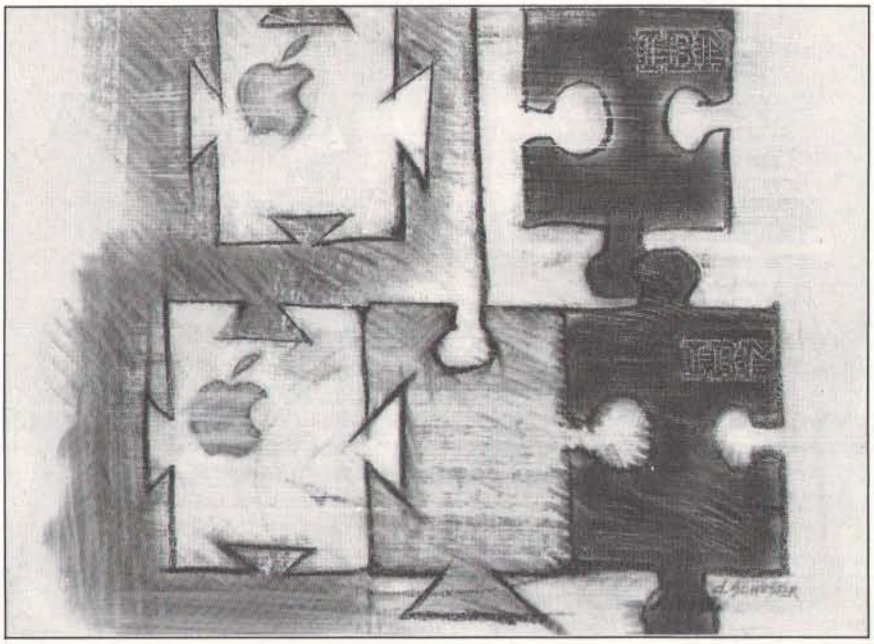
TO MAC AND BACK

Links, LANs, plug-in boards, and PC drives prove that there's more than one way to DOS a Mac

Like many of you, I have to deal with the problem of different operating systems. I have Unix workstations, Macintoshes, and IBM PC AT clones, which all have to share information. Fortunately, as far as Macs and ATs are concerned, the information-sharing possibilities are fairly well developed and can be had in a number of ways at a number of prices. Naturally, every solution isn't perfect, and every solution isn't cheap.

Since I'm more of a Mac user than a DOS user, I'll describe connections primarily from the Mac's point of view.

From the Mac, you can share information with DOS machines in several ways: direct serial connections between Macs and PCs, coprocessors that run DOS, coprocessors that run DOS or DOS emulations, disk drives that can read DOS and Mac files, and local area networks (LANs). Each method has its strengths and weaknesses.



Direct Serial and SCSI Connections
Direct serial connections offer the simplest solution. All you need is an RS-232C-compatible cable to connect the Mac's modem serial port to the COM1: serial port of the PC and some file-transfer software. Public domain terminal applications that support the Kermit and XMODEM file-transfer protocols are available for the PC and the Mac, so cost can be negligible.

The cable needed to make the connection will run you about $30 for a 12-foot length at most computer stores. Shorter cables, like the Apple Imagewriter I cable, can be purchased from authorized Apple dealers (about $30 for a 6-foot cable), although you'll also need a DB-9-to-mini DIN-8 adapter cable to use with it. Both the Mac's and the PC's serial port pin-outs are well documented, so it's easy to use some wire, parts from Radio Shack, and a soldering iron to roll your own for a lot less.

The Kermit and XMODEM protocols typically allow files to be transferred at up to 57.6K bits per second. Unless you have some special translation software or format filters, this kind of file exchange is typically limited to simple ASCII text files.

If you like your solutions prepackaged, you can buy a serial connection kit from the DataViz people. They make the popular MacLink Plus kit, which includes the necessary serial cable and software for both machines. The MacLink software works well and is a bit easier for novices to use than a public domain terminal application. It's also fairly fast at a maximum transfer rate of 57.6K bps.

But you pay for this convenience. The MacLink Plus package lists for $195, although I've seen it for as little as $130. Still, it's a good buy because the package includes a good manual and the software is nearly foolproof. Both the public domain terminal applications and MacLink Plus support modem connections for these file exchanges, in case the machines you want to connect are separated by a distance. The MacLink software will also translate the data format of many DOS data files into a format that the Mac can use, a big plus over a simple text-file transfer.

Besides direct serial connections, you can also connect your Macs and PCs using a small-computer-system-interface connection. The SCSI interface is much faster than serial ones, operating from about 1 megabit per second to 4 megabits per second. Macs already have a SCSI in-

continued

ILLUSTRATION: DAVID SCHUSTER © 1988

Items Discussed

Advanced NetWare 2.15
  Macintosh version.................$200
  NetWare LocalTalk adapter
    for AT bus $250
  NetWare LocalTalk adapter
    for PS/2 bus $350
Novell, Inc.
122 East 1700 S
Provo, Utah 84601
(800) 453-1267
Inquiry 824.

Apple PC drive and drive card ..$528
Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Inquiry 820.

AST Mac286 1.1 .... $1599
AST Research, Inc.
2121 Alton Ave.
Irvine, CA 92714
(714) 863-1333
Inquiry 821.

DaynaFile
  360K-byte 5¼-inch drive........$595
  360K-byte 5¼-inch drive and
    720K-byte 3½-inch drive $849
Dayna Communications, Inc.
50 South Main St.
Salt Lake City, UT 84144
(801) 531-0600
Inquiry 822.

MacLink Plus $195
DataViz
35 Corporate Dr.
Trumbull, CT 06111
(203) 866-4944
Inquiry 823.

QuickShare $465
Compatible Systems Corp.
P.O. Drawer 17220
Boulder, CO 80308
(303) 444-9532
Inquiry 825.

SoftPC $595
Insignia Solutions, Inc.
1255 Post St.
Suite 625
San Francisco, CA 94109
(408) 446-2228
Inquiry 826.

TOPS/Macintosh $249
TOPS/DOS
  (requires Flashcard) $189
TOPS Flashcard $239
TOPS, a Sun Microsystems Co.
950 Marina Village Pkwy.
Alameda, CA 94501
(415) 769-9669
Inquiry 827.

terface built into them, so that end of the connection is taken care of. You'll need a SCSI card for each PC, though. A SCSI card will run you about $450, according to recent mail-order ads I've seen. You'll also need some special transfer software to work across the SCSI link. Compatible Systems makes QuickShare, a product that not only allows you to transfer files between the two machines, but lets you create and use a Mac Hierarchical File System volume on the PC's hard disk. It costs $465. Still, if you frequently exchange a number of large files between a Mac and a PC, the fast SCSI connection may be a good alternative, despite the high equipment cost.

DOS Coprocessing

If you're like me, you long for a single computer that will run software from a variety of operating systems and transparently share files among the different systems. I'm still waiting for this hybrid machine to be built at a cost I can afford. In the meantime, I minimally need to run DOS and Mac software, but still want to reduce the number of computers I have hogging my desk.

In the last year or so, DOS coprocessing on the Mac has become a reality, offering a solution to my space problem, and at the same time offering another way to share files.

The first coprocessor available, from AST, is a set of two boards that plug into slots on a Mac II. The AST Mac286 board gives you the processing power of an 8-MHz AT inside your Mac II. At $1599, though, the cost is high, and that doesn't include the price of a drive and NuBus board you'll need to read MS-DOS disks. I've owned two of them since they first came out last November, but only since June have I been able to use them as AST intended; it took that long for the company to issue a software update to the painfully slow video drivers that came with the first release (1.0).

The Mac286 1.1 is now a nice implementation, and one that you can use as a guide to other coprocessing solutions. Such solutions should be able to read DOS files from an attached PC drive (I use the Apple PC drive); partition the Mac's hard disk so it can store DOS files; emulate monochrome, CGA, and Hercules video; and exchange files between the DOS and Mac environments using Apple's File Exchange software. AST expects to release an SE version of this coprocessor sometime this year.

Besides hardware coprocessing, at least one company, Insignia Solutions, offers a software PC emulation for the Mac II, called SoftPC. I've used SoftPC 1.01 for several months now, and it's a good product. It's slower than AST's hardware product, working at about the speed of a 4.77-MHz XT. But its video emulation is excellent, and I have not yet found any DOS software it can't run. Cutting and pasting between DOS applications and Mac applications is also supported (as it is with the Mac286). SoftPC is less expensive than the Mac286, at $595. Still, if all you need is to exchange files between the two machines, any kind of coprocessing seems like costly overkill to me.

The Disk Drive Solution

Whether you are using a hardware or a software DOS coprocessor, you need some way to read DOS-formatted disks using your Mac. If all you need is data compatibility and interchange, a DOS drive for your Mac may be all the hardware you need. Apple and Dayna Communications make PC-compatible disk drives for the Mac. The Apple drive uses a supplied controller card that plugs into either the SE's Eurobus slot or a Mac II's NuBus slot. It reads and writes 360K-byte 5¼-inch floppy disks. The Apple drive is not under Finder control directly; it won't appear on the Desktop. Instead, you read and write to it using Apple's File Exchange utilities. The Apple PC drive costs $528, including the controller card.

The DaynaFile connects to any Mac's SCSI port and can be had in a variety of formats, including 360K-byte and 1.2-megabyte 5¼-inch, and 720K-byte and 1.44-megabyte 3½-inch. The DaynaFile does appear on the Desktop, and files on the drive can be manipulated directly by the Finder and other applications. Software for PC-to-Mac and Mac-to-PC file

continued

Can your lightweight database handle a heavyweight challenge?

When you have a job that's too much for dBASE or Paradox, turn to the real heavyweight. PC/FOCUS.

PC/FOCUS is the number one fourth-generation language, with its own powerful database system. It's complete enough to create the complex reports and applications that others can't—without resorting to hard-to-learn procedural languages.

With the PC/FOCUS window painter, you can do highly customized, menu-driven applications, with help screens and overlaid windows.

Using just a few words in the PC/FOCUS 4GL, you can put together highly structured matrix reports that include imbedded data, row and column totals, and customized headings. You can create any standard financial report in your preferred format.

And you can draw on as many as 16 different files for one report.

With the powerful PC/FOCUS shared-relational database system, you can report at a level of detail that would otherwise require a large computer. PC/FOCUS can scan 50,000 records in less than three seconds.

And you can access this power through a choice of user interfaces. A command mode lets the experienced user develop major applications quickly. A point-and-pick windowed interface lets the casual user make a query—or build a substantial application—using only the arrow keys and the enter key.

What's more, any application you develop in the FOCUS language can immediately be run on any of the larger computers supported by FOCUS.

PC/FOCUS includes modules for graphics, statistics, and communications. And there are optional modules including EQL—an English language interface, spreadsheets with goal-seeking capabilities, and interfaces to dBASE and other PC database systems.

There's also a MultiUser version of PC/FOCUS that works with the major LAN products. In a network, up to 32 users can access one database simultaneously without record lockup. While PC/FOCUS maintains your data integrity.

If you've got a heavyweight job to do, get some real muscle from PC/FOCUS. Call 1-212-736-4433, Ext. 3700. Or write Information Builders, Inc., 1250 Broadway, New York, N.Y. 10001.

PC/FOCUS
Information Builders, Inc.

Circle 111 on Reader Service Card

translations is included, a nice touch. The price of the DaynaFile varies according to the physical formats you select, ranging from $595 for a single-drive unit up to about $850 for a dual-drive box.

Networking Solutions

All the connection methods mentioned so far have one big drawback: They require you to think about the file-exchange process and what it entails. In other words, you have to actively keep the file-transfer process in mind. One way to get around that inconvenience is to set up a LAN of shared Macs and PCs. A properly set up LAN allows you to forget where files are stored and in what format, since the LAN takes care of the necessary access protocols and file translations or filters as required.

There are currently two LAN products available that allow Macs and PCs to be connected to one another transparently: TOPS from Sun Microsystems, and Novell's Advanced NetWare for the Mac. In both cases, once you have established the LAN, with its cable connections, adapter cards (used by the PCs, since the Mac's printer port serves as its physical AppleTalk connection), and so on, the LAN software takes care of the rest.

The software translates data files from a native DOS format to one that a Mac can read, and vice versa (depending on the applications software, of course). It also provides transparent access to printers (including PostScript devices), stores files as needed on any available network hard disk, and provides electronic mail services. In short, a complete LAN implemented across two different operating systems (DOS and Macintosh) provides a high level of interoperability that you just can't get with any of the other file-exchange methods I've listed.

A TOPS network will cost you about $250 per Mac, and about $430 per PC (including the necessary PC-AppleTalk card), plus the cost of LocalTalk cabling. A Novell LAN costs about $899 for the server software and another $300 for each of the PC adapter cards needed. The level of file integration and exchange, however, is the current state of the art. ■

Don Crabb is the director of laboratories and a senior lecturer for the University of Chicago's computer science department. He is also a consulting editor for BYTE. He can be reached on BIX as "decrabb."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Circle 123 on Reader Service Card

Quality Was Never Priced So Low!

2400 bps ONLY $100

2400 / 1200 / 300 bps

MODEM

MADE IN U.S.A.

5 Year Parts and Labor Warranty

Our **2400HC²** **H**ayes **C**ompatible **H**alf **C**ard modem is for IBM PC/XT/AT and compatible computers. It uses the standard 'AT' command set. Included with our modem we supply communications software, a 7 foot cord and documentation.

We build our modems at a mil-spec board house located in suburban Chicago, using quality components. We test every modem shipped and back our confidence in our quality with a 5 year parts and labor warranty from the factory and a 30 day money back guarantee.

Kiss Engineering Inc.

162 N. Franklin St. • 5th Floor • Chicago, IL 60606
Toll Free Order Line for orders only 1-800-442-2285
For orders in Illinois 1-312-358-1501
Kiss Engineering Technical Support 1-800-442-2285

Orders within the USA (including Alaska & Hawaii) are shipped FREE via UPS.
Payment in U.S. funds drawn on a U.S. bank required.
COD orders placed before 2 pm CST shipped same day.
Illinois residents add 8% sales tax.
We do not accept credit cards.
Please send check or money order for $100.

Speech

For over seven years the Echo™ speech output products from Street Electronics have set the standard for reasonably priced voice equipment.

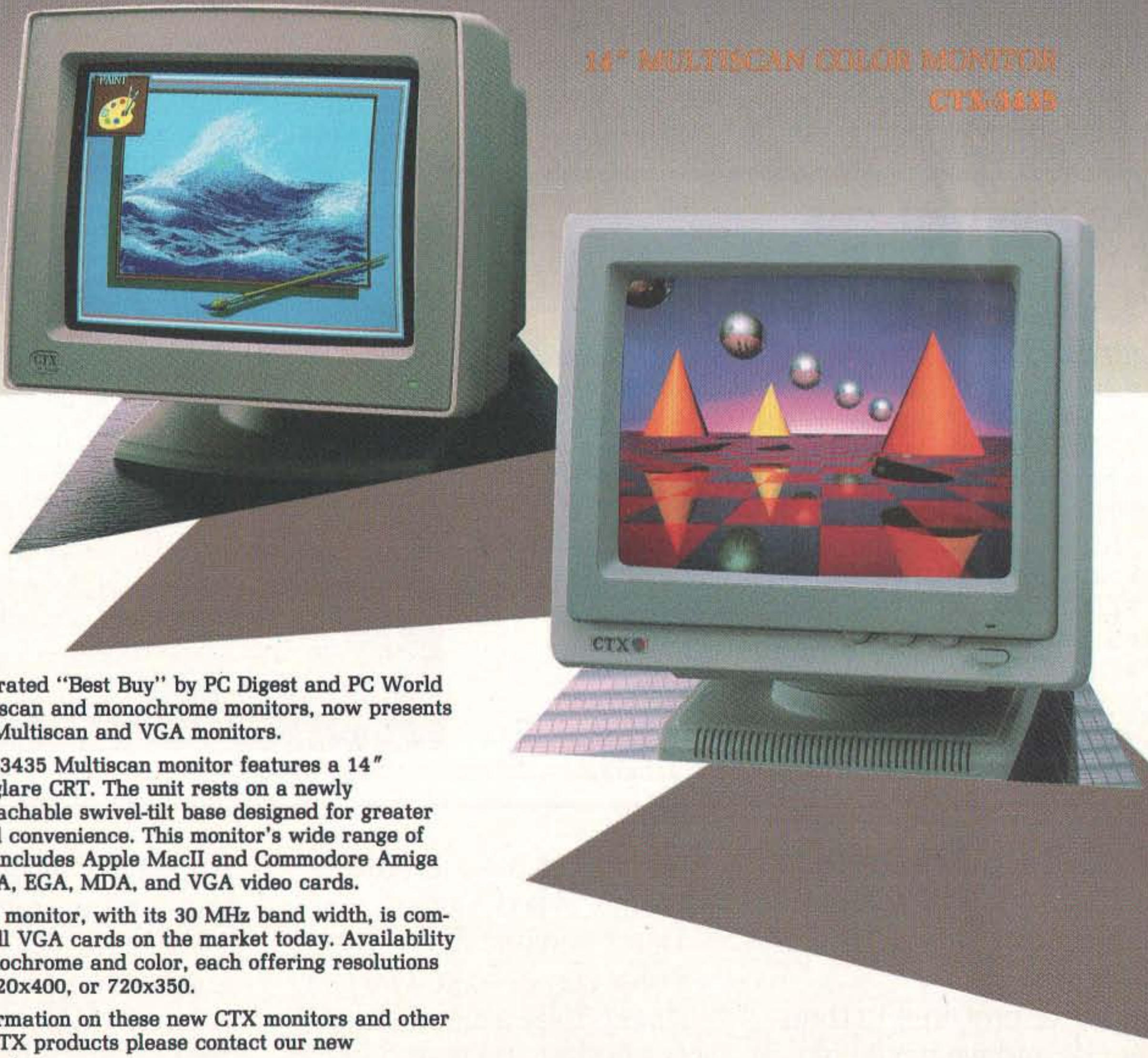
There are now two new Echo speech boards for MS DOS®-based machines: the Echo MC for the IBM Personal System/2 Micro Channel™ products, and the ECHO PC+ for the IBM PC and compatibles. These products utilize the new Echo speech chip which processes digitized voice; natural sounding LPC voice, and unlimited vocabulary text-to-speech.

Street Electronics Corporation

6420 Via Real, Carpinteria, CA 93013 (805) 684-4593

Circle 216 on Reader Service Card

CTX
Presents



CTX, already rated "Best Buy" by PC Digest and PC World for their multiscan and monochrome monitors, now presents its NEW 14" Multiscan and VGA monitors.

The new CTX-3435 Multiscan monitor features a 14" diagonal non-glare CRT. The unit rests on a newly developed detachable swivel-tilt base designed for greater versatility and convenience. This monitor's wide range of compatibility includes Apple MacII and Commodore Amiga as well as CGA, EGA, MDA, and VGA video cards.

The new VGA monitor, with its 30 MHz band width, is compatible with all VGA cards on the market today. Availability is in both monochrome and color, each offering resolutions of 720x480, 720x400, or 720x350.

For more information on these new CTX monitors and other high quality CTX products please contact our new headquarters at:

CTX INTERNATIONAL, INC.
161 Commerce Way
Walnut, CA 91789
TEL: (714) 595-6146 • FAX: (714) 595-6293

EASTERN REGIONAL OFFICE
CONTINENTAL TECHNOLOGY, INC.
300 McGAW DRIVE
EDISON, NEW JERSEY 08837
TEL: (201) 225-7377 FAX: (201) 225-6355

FACTORY
CHUNTEX ELECTRONIC CO., LTD.
ROOM 401, NO. 50 SEC. 1,
HSIN-SHENG S. RD.,
TAIPEI, TAIWAN, R.O.C.
TEL: (02) 3921171 FAX: (02) 3919780

Apple MacII is a registered trademark of Apple Computer, Inc.
Amiga is a registered trademark of Commodore-Amiga.

Circle 61 on Reader Service Card (DEALERS: 62)

DAZZLING PERFORMANCE.

'286/SS

COMPLETE 12MHz '286 WITH 32MB HARD DRIVE

ONLY $1295.00

- 80286 CPU, 8/12.5 MHz Dual Speed, Keyboard Selectable.
- *Zero-Wait* State RAM, 512K expandable to 4MB on the motherboard (16MB System Total).
- 32MB Hard Drive, 1.2MB Floppy Drive.
- *Ultra high speed* Hard/Floppy controller. 1:1 interleave, 800 KB/sec transfer rate.
- High Res 12" Amber Display with Tilt and Swivel Base. Compatible graphics controller.
- ZEOS Enhanced Keyboard, Pleasant Tactile/Click Feel.
- Serial and Parallel Printer Ports.
- Clock/Calendar with Battery Backup.
- 6-16 and 2-8 bit expansion slots.
- 80287 support, up to 12 MHz.
- Space Saver Case with Security Lock, LED indicators.

12MHz, 16MHz and 20MHz '286 HARD DRIVE SYSTEMS

As high as *20MHz!* Dazzling performance is yours with one of these high performance full size ZEOS '286 Systems.

Each comes *complete* with our standard features including drives, monitor, high speed controller, etc. Our full size case features room for up to 5 half-high drives, two of which are internal. Incredible values.

- **286/12**—Complete 12.5MHz System with 512K of Zero-Wait RAM, High Speed 32MB, 33ms Hard Drive and all the standard ZEOS goodies. **ONLY $1395.00**
- **286/16**—Complete 16MHz system with *1MB* RAM on board and High Speed 32MB Hard Drive. *Faster than a '386* 16MHz when running 16-bit software! **ONLY $1895.00**
- **286/20**—At 20MHz, it's the fastest. Complete with our 32 MB, 33ms Hard Drive and *1MB* RAM. This is what Dazzling Speed is all about. **ONLY $2095.00**

'286/FS

DAZZLING PERFORMANCE. INCREDIBLE PRICES.

Can you believe it? *Yes, you can!*

We've proven it to thousands and we would like to prove it to you. ZEOS® systems are sold *complete,* ready to plug in and fly right out of the box. And the quality and prices are incredible.

How is it possible? Because your ZEOS computer comes to you *factory direct,* fully assembled, burned-in and tested in our own laboratories. Every system is built to order. Custom built actually, right to your own specifications. And our quality and performance are second to none.

We don't just say it. We guarantee it. That's why your new ZEOS system comes with a Full One Year Limited Warranty and our 30 day Full Refund Satisfaction Guarantee.

So pick out your dream

All prices and specifications are subject to change without notice. Please call for current details. Call for complete warranty details.

INCREDIBLE PRICES.

'386/DT

COMPLETE 16MHz '386 DESKTOP WITH 32MB HARD DRIVE.

ONLY $2495.00

(20MHz add $500)

- Genuine 32-bit Intel 80386, 16 or 20MHz parts.
- *1MB* of RAM Expandable to 16MB.
- 32MB, 33ms Hard Drive, 1.2MB floppy drive.
- *Ultra high speed* Hard/Floppy controller. 1:1 interleave, 800 KB/sec transfer rate!
- High Res 12″ Amber Display with Tilt and Swivel Base. Compatible graphics controller.
- 101 Key ZEOS Tactile Click keyboard.
- Serial and Parallel/Printer Ports.
- Clock/Calendar with Battery Backup.
- 2-32, 4-16 and 2-8 bit slots.
- 80287 and 80387 support.

COMPLETE '386 VERTICAL SYSTEM. 64MB DRIVE!

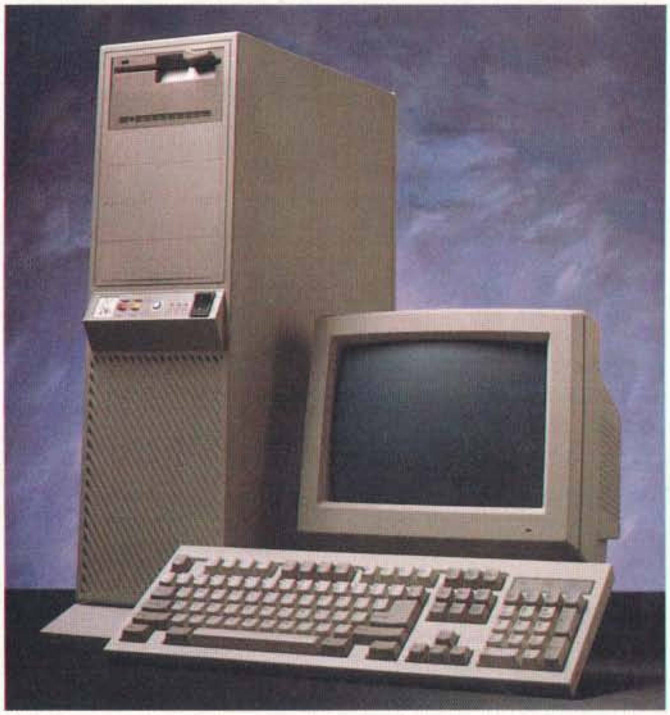
ONLY $2995.00

(20MHz add $500)

Acknowledged worldwide as the highest performance value anywhere. Same great standard ZEOS features found on our other complete systems plus:

- 64KB Zero-Wait CACHE using 64K of SRAM.
- 1MB of 32-bit RAM system expandable up to 16MB.
- *64MB* Seagate Hard Drive.
- 80287 and 80387 optional.
- Heavy Duty Vertical Case.

Ask about our *25MHz* systems too!



'386/V

---

machine and order it now with confidence. Dazzling performance and incredible prices await you. *Guaranteed.* Order now by calling 800-423-5891.

Other ZEOS Options Include:

- Basic Configurations: Call for prices on systems without drives, etc.
- EGA/VGA Upgrades. 14″ EGA color monitor with EGA card, add $495. 14″ VGA system, add only $695
- High Capacity Drives. Many other drives and options are available. Call Toll Free for details, 800-423-5891

ORDER NOW TOLL FREE 800-423-5891

FAX Orders Dial: 612-633-2310
In Minnesota Call: 612-633-4591
530 5th Ave. NW, St. Paul, MN 55112
Open days, evenings and weekends.
MasterCard, VISA and C.O.D.
Se habla Español.

ZEOS® INTERNATIONAL LTD.

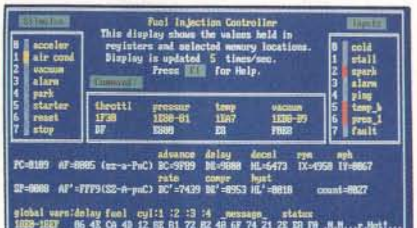
ZEOS International, Ltd., 530 5th Avenue, NW, St. Paul, MN 55112. ZEOS is a publicly traded company; MPLS/ST. PAUL Local OTC.

Circle 232 on Reader Service Card

0 to 60 in 5 seconds

with new UniLab 8620 analyzer-emulator.

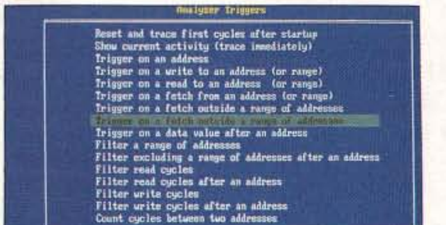
- 64Kbytes from hard disk in 5 seconds. That's moving. But today you've got to be fast just to stay in the race for better microprocessor designs.
- The secret is a new, high-speed parallel interface: the Orion bus. Which zips data between your PC/AT and the 8620 analyzer-emulator, breaking the RS-232 bottleneck.
- The 8620 with O-bus gives you complete program diagnosis — and solutions — in real time. For more than 150 different microprocessors. Using **the same command set** environment.
- A generous 2730 trace-cycle buffer with selective filtering lets you cut through the clutter and display just the traces you wish. And you get 1μsec resolution in program time measurement. Plus continuous InSight monitoring of your program's key functions as they are performed.



```
                 Fuel Injection Controller
          This display shows the values held in
           registers and selected memory locations.
           Display is updated  5  times/sec.
                     Press      for Help.
0   acceler                                               0   cold
1   air cond                                              1   stall
2   vacuum                                                2   spark
3   alarm                                                 3   alarm
4   park                                                  4   ping
5   starter    throttl     pressur     temp    vacuum     5   temp_h
6   reset      1F38        1E80-01     1EA7    1E80-09    6   pres_1
7   stop       DF          E800        E8      F8E8       7   fault

                          advance  delay    decel    rpm      mph
PC=0109  AF=0005 (sz-a-PnC) BC=9F09  DE=9080  HL=6473  IX=4958 IY=0067
                          rate     compr    hyst
SP=0000  AF'=FFF9(SZ-A-pnC) BC'=7439 DE'=0953 HL'=0018     count=0027

global vars:delay fuel  cyl:1 :2 :3 :4  _message_   status
1E00-1E0F   06 4E CA 4D 12 0E 01 72 02 48 6F 74 21 2E E0 F0 .N.M...r.Hot!...
 stack
1EF0-1EFF   E2 4D 18 00 00 24 72 64 00 98 09 9F 73 64 E0 F0 .M...$rd....sd..
```

InSight Display. InSight blends analyzer-emulator techniques to give you continuous, real time monitoring of key processor functions. And still services user interrupts. It displays changing register contents, I/O lines, ports, user-defined memory windows. With your own labels.

- On top of that, you get UniLab's trademark ability to debug by symptom, not just by breakpoint and single step. And, to help you complete the job on time, on the spot, a stimulus generator and EPROM programmer are included.
- Ease of use, another Orion trademark, is also built in. So you have all the familiar features and formats you're used to working with. It doesn't matter if your project is a single chip controller or complex 16-bit microprocessor, the 8620 is the top price/performance analyzer-emulator that does it all. At just $4380. With processor Personality Paks typically $550 each.
- UniLab 8620. Fast-lane debugging that gets you to market quicker.



```
                    Analyzer Triggers

     Reset and trace first cycles after startup
     Show current activity (trace immediately)
     Trigger on an address
     Trigger on a write to an address (or range)
     Trigger on a read to an address  (or range)
     Trigger on a fetch from an address (or range)
     Trigger on a fetch outside a range of addresses
     Trigger on a fetch outside a range of addresses
     Trigger on a data value after an address
     Filter a range of addresses
     Filter excluding a range of addresses after an address
     Filter read cycles
     Filter read cycles after an address
     Filter write cycles
     Filter write cycles after an address
     Count cycles between two addresses

       Press  PgDn  or  PgUp  to scroll.  Esc  to exit.
       Press ↓↑ to select._
```

Analyzer Triggers. Commonly used triggers can be selected quickly from a list of standard and user-defined triggers.

Call toll-free: 800/245-8500.
In CA: 415/361-8883

ORION
INSTRUMENTS

702 Marshall St., Redwood City, CA 94063
TLX 530942 FAX 415/361-8970

Computer Integrated Instrumentation

Circle 162 on Reader Service Card

FIRST IMPRESSIONS ■ Rich Malloy

DOS 4.0

The world's most widely used operating system finally gets a friendly interface

The familiar C> prompt of DOS is perhaps the most common sight in the computer world today. To first-time users, it is probably also the most intimidating. Many programs have sought to rectify this situation, and some have succeeded nicely. Now, in version 4.0, DOS can finally mask itself from users.

DOS 4.0, from IBM and Microsoft, has a number of new utilities and some minor improvements to existing utilities. It can also handle disk drives larger than 32 megabytes. But the most significant change for the new DOS is its DOS Shell, a graphics-based interface that features windows, pull-down menus, and mouse support.

Hiding the C> Prompt

Anyone who has looked at other personal computers and then glanced back at the C> prompt of DOS has realized that something was lacking. A number of software manufacturers, such as Executive Systems (manufacturer of XTree) and Peter Norton Computing (the Norton Commander) have created menu-based interfaces for DOS. These packages display a menu of programs or files in a directory and allow you to "point and shoot" to run the individual programs.

But despite all these developments, the underlying DOS retained much the same look and feel as it had back in 1981. Until this summer, that is, when IBM and Microsoft released DOS 4.0. The DOS Shell included with 4.0 is a clear first step toward user-friendliness. But, like many first steps, it does exhibit a certain amount of unsteadiness.

The New Shell Game

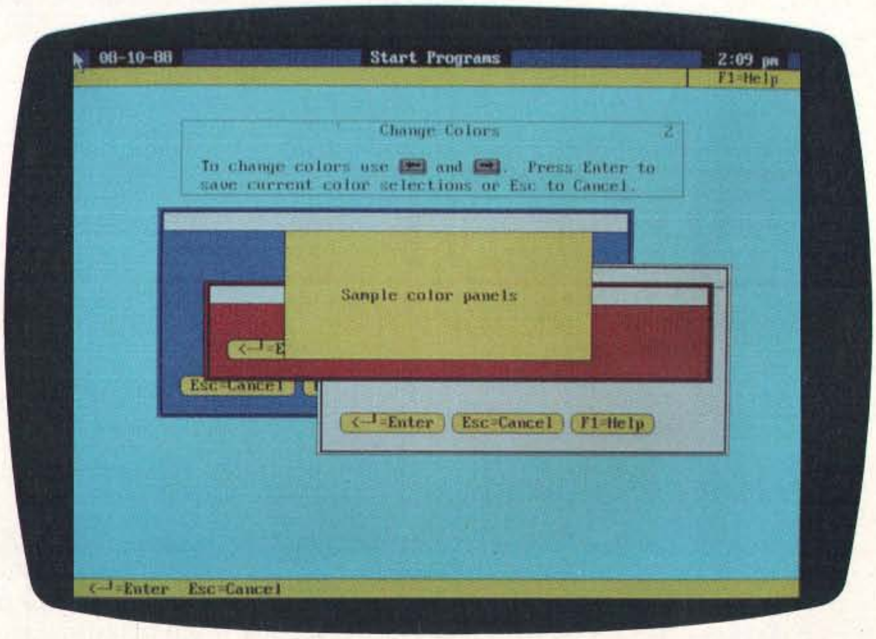
The DOS 4.0 Shell program (see photo 1) runs on a wide range of graphics display adapters. On a VGA, the program takes advantage of the 480- by 640-pixel resolution that is available and offers up an impressive image, complete with icons and windows. The program also runs effectively on other adapters, including EGA, CGA, and even the nongraphics MDA. Unfortunately, the program suffers from IBM's "not-invented-here" syndrome: It does not support the popular Hercules monochrome graphics adapter.

The DOS Shell basically consists of two parts: a front-end menu called simply "Start Programs" and a file-handling module called the File System. The Start Programs menu allows you to quickly select one of several "programs" or batch files. Each batch program can have a long descriptive name and its own help message, which you can call with the F1 key.

Think of the Start Programs menu as an enhancement of the batch-file capability of DOS. With the enhanced batch commands, you can write a batch program that will display a window and prompt the user for additional information. You can also set up the batch program to run only when the user enters the correct password.

For example, if you have trouble remembering how to use the Find utility in

continued



To change colors use ◄ and ►. Press Enter to save current color selections or Esc to Cancel.

Photo 1: *The most striking feature of DOS 4.0 is its Shell program. The first part of the program, called "Start Programs," consists of a menu of possible batch programs to run. One of these programs allows the user to change the colors used by the Shell program.*

Circle 234 on Reader Service Card (DEALERS: 235)

Build Better
BASIC Programs...

QuickWindows™
State-of-the-art user-interface manager • Save time creating windows, pop-up and pull-down menus, help windows, list boxes, and dialog boxes • Powerful input function with data validation • Supports Microsoft-compatible mouse • Free demo/tutorial disk available
Without Assembly Source **$79.**
With Assembly Source **$99.**

QuickWindows™ Advanced
Complete user-interface manager • An enhancement to the popular QuickWindows • "Multi-tasking" menus • High-level dialog box functions - pushbuttons, radio buttons, checkboxes, rangebars, input boxes, and list boxes - scan them all with one command! • Message boxes • More mouse functions • Supports text and graphics modes through VGA SCREEN 13 • Free demo/tutorial disk
Available NOW! **$139.**

QuickGuides™
Complete online reference manuals available for all our libraries and QuickBASIC 4.0! • While editing, just place cursor on a function name and press a hot key...INSTANT HELP!
Database Only for one of our libraries **$49.**
Database for QuickBASIC 4.0 **$49.**
Database with Norton Guides Engine **$79.**

QuickCOMM™
Full-featured communications library • Supports up to 16 serial ports with interrupt-driven service • Supports Hayes®-compatible modems • XMODEM, YMODEM, and XON/XOFF file transfer protocols • Works optionally with QuickWindows • Easily create BBS, terminal, test equipment and other machine-interface software.
Available December 1988 **$139.**

All of our libraries work with Microsoft QuickBASIC or BASCOM compilers. All come with extensive documentation, example programs, and a 30-day money-back guarantee. We offer technical support and free access to our 24-hour Syslink™ BBS. Visa/MC/COD accepted.

401-274-5465

Software Interphase INCORPORATED
5 Bradley Street, Suite 101
Providence, RI 02908

Trademarks: Norton Guides (Peter Norton Computing), QuickBASIC (Microsoft Corporation)

DOS, you can set up a batch program called "Find a Text String in a File." You can write the program so that it asks the user for the string to search for and the name of the file to look at. The batch program can then call the Find program and feed it the parameters in the correct order.

One problem with the batch programs is that you can edit them only through a small, horizontally scrolling window. Another possible deficiency is that, though most older batch commands are supported, `GOTO` is not.

Easy File Handling

The second interesting part of the DOS Shell is the File System module (see photo 2). This module, which you call from the Start Programs menu, starts up by showing two windows. On the left is a graphical representation of the subdirectory structure of a disk drive; on the right is a scrolling list of files from one of the directories.

You can use the File System to do many of the traditional DOS tasks. Once selected, files can be easily copied, deleted, or moved. The files can be viewed (in ASCII and hexadecimal code), and their attributes can be changed (read-only, hidden, or archived).

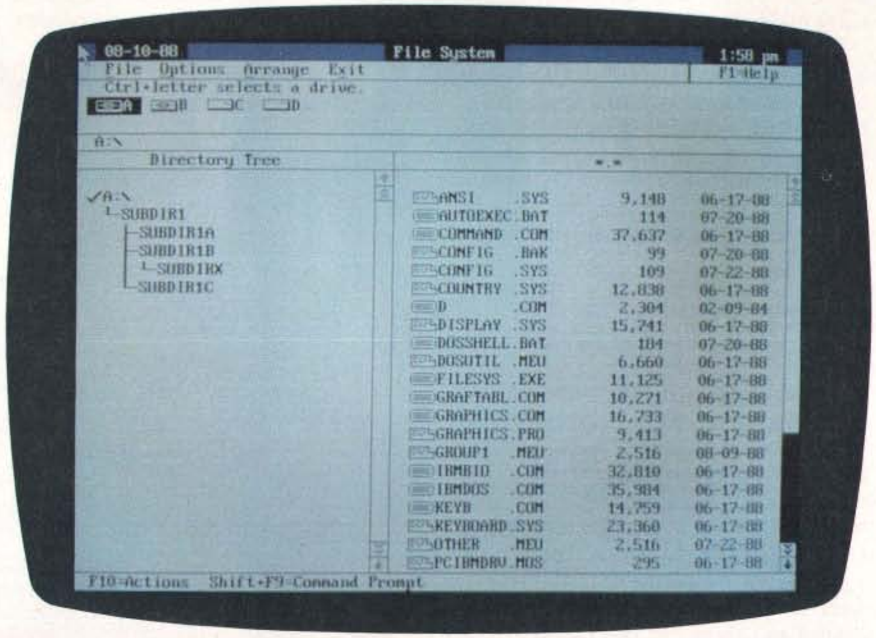
You can also associate a particular filename extension with a certain application. Then, when you select a filename with that extension, the associated application is executed with the filename as a parameter.

While the Shell does have some nice features, it seems to fall short in a couple of areas. One is size. All the files needed to run the Shell will almost completely fill a 360K-byte disk. The DOS Shell seems aimed at hard disk drive systems. On a floppy disk–based system with one disk each for the DOS Shell, applications, and data, you will find yourself doing a lot of disk swapping.

You may also be doing quite a bit of waiting. The DOS Shell seems to do a significant number of disk accesses. For example, despite its large size, the DOS Shell program has no DOS-like capabilities; if you select a simple DOS function, such as showing a directory, the Shell has to take the time to reload COMMAND.COM, list the directory, and then reload the Shell.

Of course, you can speed up the program by running it in "resident" mode, but then you run into memory problems. In its usual "transient" mode, the Shell will transfer control back to the operating system, leaving a small resident kernel of 10K bytes. The small kernel will

continued



```
Ctrl+letter selects a drive.
A:\
✓A:\
 └SUBDIR1
   ├SUBDIR1A
   ├SUBDIR1B
   │ └SUBDIRX
   └SUBDIR1C

*.*
ANSI    .SYS     9,148  06-17-88
AUTOEXEC.BAT       114  07-20-88
COMMAND .COM    37,637  06-17-88
CONFIG  .BAK        99  07-20-88
CONFIG  .SYS       109  07-22-88
COUNTRY .SYS    12,838  06-17-88
D       .COM     2,304  02-09-84
DISPLAY .SYS    15,741  06-17-88
DOSSHELL.BAT       184  07-20-88
DOSUTIL .MEU     6,660  06-17-88
FILESYS .EXE    11,125  06-17-88
GRAFTABL.COM    10,271  06-17-88
GRAPHICS.COM    16,733  06-17-88
GRAPHICS.PRO     9,413  06-17-88
GROUP1  .MEU     2,516  08-09-88
IBMBIO  .COM    32,810  06-17-88
IBMDOS  .COM    35,984  06-17-88
KEYB    .COM    14,759  06-17-88
KEYBOARD.SYS    23,360  06-17-88
OTHER   .MEU     2,516  07-22-88
PCIBMDRV.MOS       295  06-17-88
```

Photo 2: *The File System module of the DOS 4.0 Shell program allows easy access to individual files. In this representation of the File System menu, which was generated on a VGA display, there is a graphical representation of the subdirectory tree structure on the left and a scrolling list of filenames on the right. Along the top is a list of pull-down menus. The File System module allows you to copy, delete, move, and execute files easily.*

Which would you like to see first? The world's fastest dBASE compiler or the most powerful database development language?

Surprise. Now you get both in the same package. New Clipper™ from Nantucket.®

Our latest version—Summer '87—is still the best-performing compiler ever. It lets users run dBASE® applications up to 20 times faster. But there's a lot more to it than raw speed.

Because new Clipper is one of the most powerful, full-featured development languages ever. And gives you more control over your applications than any release of dBASE ever will. Now or in the future.

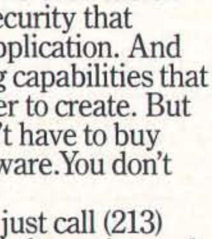
Instead of designing Clipper as an add-on, we've structured it as an extended database language that uses dBASE as a subset. In addition to emulating the dBASE language, we've added commands for menus, screens, windows and extended functions. As a result, you get dBASE compatibility and an entirely new level of power and versatility.

And with Clipper's open architecture, you can write functions in Clipper, C, Assembler or other languages, and integrate them into one seamless application. Which helps you create more sophisticated applications in less time. And by using our full-featured debugger, you'll be done even faster.

We also give you source code security that keeps users from damaging your application. And sophisticated record and file locking capabilities that make networking applications easier to create. But no matter what you create, you don't have to buy runtime modules or additional software. You don't even have to pay licensing fees.

If you haven't tried Clipper yet, just call (213) 390-7923 today. We'll send you full information and a free demo diskette. Or the complete program, if you'd rather.

But call today. And see how easy it is to find the best dBASE development language. Just get the fastest compiler. And open the box.



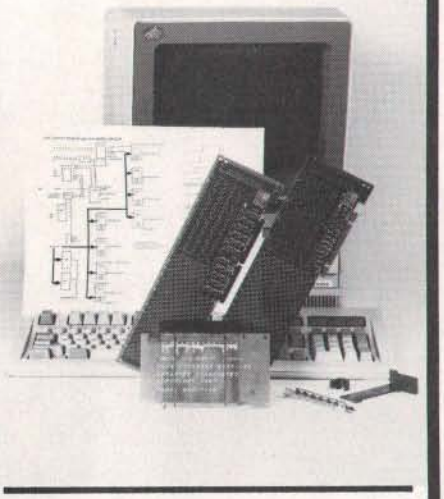
Clipper™

Nantucket, 12555 W. Jefferson Boulevard
Los Angeles, CA 90066 Telex: 650-2574125

© Nantucket Corporation, 1988. Nantucket is a registered trademark and Clipper is a trademark of Nantucket Corporation. dBASE is a registered trademark of Ashton-Tate.

Circle 153 on Reader Service Card

Circle 139 on Reader Service Card



PS/2™

Compatible Products
Everything for PS/2 machines

- WIREWRAP CARDS high quality design in 6 sizes
- EXTENDER CARDS
- BRACKETS
- DESIGN EXAMPLES
- TECHNICAL DETAILS
- ASIC CHIPS
- PS/2 NEWSLETTER
- CALL FOR OUR FREE CATALOG

ONTARGET TARGET TARGET TARGET

ON TARGET Associates
1034 W. Maude Ave. #602
Sunnyvale, CA 94086
408-980-7118

PS/2 is a registered trademark of IBM Corp.

While the DOS 4.0 Shell has a number of nice features, it seems to fall short in a couple of areas.

call back the rest of the Shell program when you type `EXIT` on the DOS command line.

In resident mode, however, the Shell stays completely in memory all the time. In fact, it leaves little room for anything else. The version I tested, which obviously had a bug, left only 65K bytes available for other programs. This was not even enough to run the `CHKDSK` utility. Curiously, the program always left 65K bytes, no matter how much memory it had available to begin with.

The program's support for mouseless systems is less than you might expect from a company that developed Windows and Excel. In fact, for keyboard-based users, there is enough of a difference between the Shell and Microsoft Windows to be somewhat annoying. For example, the Shell, like Windows, displays a horizontal row of menu names at the top of the screen. In Windows, you can call the pull-down menus associated with these names by using a simple Alt key combination. In the Shell, however, you must either hit the Tab key until the cursor moves up to the menu row or hit F10. You can eliminate this problem by using a mouse, but then another problem arises: speed. When I used a Microsoft mouse on a 6-MHz AT clone, there was a very noticeable delay each time I selected an item.

One other concern about the Shell involves copy protection. The new Shell is not exactly copy-protected, but it is not easily copied, either. IBM has provided a program, called SELECT, that helps you install the operating system on your hard disk or a set of floppy disks. Once you install the operating system, you can copy it to other floppy disks.

For some strange reason, however, IBM has decided to copy-protect the SELECT program. It will run only when you execute it from the original IBM floppy disk. In fact, IBM has employed an old but simple copy-protection trick: SELECT looks for a certain hidden file of length 0.

Another problem with SELECT is that it does not recognize certain non-IBM hard and floppy disk drives. You may be forced to install your system on floppy disks and then copy it over to your hard disk.

New DOS Utilities Keep Track of Memory

DOS 4.0 has an interesting new utility, MEM, that is designed to show how your system memory is allocated. If you invoke the program using the command `MEM /PROGRAM`, the program will display a memory map showing which program uses which areas of memory.

In addition, some of the existing commands have been enhanced. Many of the commands, such as `BUFFERS` and `VDISK`, can now make use of non-IBM expanded memory. I could not, however, get this feature to work with my Intel Expanded Memory Specification card.

The `DEL` or `ERASE` command now has a /P parameter. With this parameter set, the program will ask you to verify each program before it is erased.

Perhaps most important, the utility FDISK now allows you to create partitions on your hard disk that are larger than 32 megabytes.

Replace Your Old DOS?

The new version of DOS is significantly different from previous versions. But with a price of $150 for the IBM version ($90 for an upgrade), it is also significantly more expensive. Many users may opt to continue to use older versions of DOS with existing DOS shells. Others may choose environments such as Windows or DeskMate.

Of course, if you require support for very large hard disk drives, DOS 4.0 is almost a necessity. However, other users may prefer to stick with the old `C>` prompt. If nothing else, it rarely gets in the way.

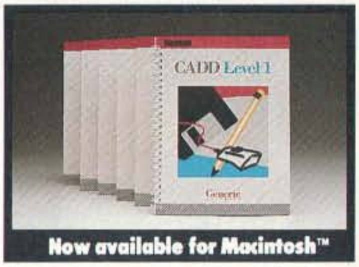
One other hesitation you may have about the new DOS is that it is probably not compatible with many programs that directly access disk drives. For example, old versions of the Norton Utilities will crash with the new DOS. But, by the time you read this, new versions of these utilities will probably be available for DOS 4.0. ■

Rich Malloy is the associate managing editor of BYTE's news and technology section. He can be reached on BIX as "rmalloy."

NOW YOU CAN DESIGN JUST ABOUT ANYTHING... INCLUDING YOUR OWN CADD SYSTEM!

Anyone can produce a computer-aided drafting and design package that sells for thousands of dollars. But creating one that's fast, powerful, and affordable takes real ingenuity.

That's exactly what we've done at Generic Software.™ We sell the most widely used CADD program in the world for under $500.



Now available for Macintosh™

PC Magazine ranked it "Editors Choice" in a face off with 17 low-cost CADD packages. "This product is an outstanding value from every point of view and is highly recommended." "A paperback version of AutoCAD", stated PC Week.

And our CADD programs are just part of what we offer.

You can start with Generic CADD Level 1,™ then advance to other levels as your needs—and skills—expand.

And you can use our CADD add-ons, Utilities, and symbols libraries to design the CADD system that fits your needs.

You only pay for the functionality you need, and the functionality you get has depth.

Critic tested, market approved. Generic Software offers price, quality, and support. Match our customer support against anyone!
- Unconditional 60-day guarantee on most products
- Unlimited free technical support
- Free monthly newspaper
- Regular updates at modest prices. All adding up to prove that the only thing generic about us is the price.

Call us for a free CADDalog™ or for the name of your local dealer: 1-800-228-3601.

© Generic Software Inc., Level 1 and Generic CADD are trademarks of Generic Software Inc., 11911 North Creek Parkway South, Bothell, WA 98011. Macintosh is a trademark of Apple Computer Inc.

Generic
SOFTWARE

Circle 93 on Reader Service Card
(DEALERS: 94)

Visit us at COMDEX 88. Booth H7662

BEST

NEW MINI PORTABLE BEST-286 LCD

- ☐ 10 MHZ 0 WAIT (12 MHZ Option)
- ☐ 512 K RAM
- ☐ 1.2 M. Floppy Drive
- ☐ 20 MB Hard Disk
- ☐ 165 W DC Fan Power Supply
- ☐ Serial & Parallel
- ☐ Non-Glare LCD Screen
- ☐ Super Twist
- ☐ Built-In Back Light
- ☐ 640 x 200 Dots (640 x 400 Optional)
- ☐ Weight 22 lbs
- ☐ Padded Soft Carry Bag
- ☐ Dimension 16" x 8" x 9"

$1650

BEST-286 DESK TOP

- ☐ 12 MHZ
- ☐ 512 K RAM (4MB RAM Expandable)
- ☐ 1.2 MB Floppy
- ☐ EGA Monitor
- ☐ EGA Card (Paradise Compatible)
- ☐ 20 MB H.D. (ST-125 28ms)
- ☐ Serial & Parallel Port
- ☐ 8 I/O Slots
- ☐ 200 W ⓊⓁ Power Supply
- ☐ Fujitsu 101 Enhanced Key Board

$1675

BEST-88 DESK TOP $ 605

BEST-286 PORTABLE

- ☐ 12 MHZ
- ☐ 512 K RAM
- ☐ One 1.2 MB Floppy Drive
- ☐ 7 Expension Slots
- ☐ 200 W DC Fan Power Supply
- ☐ 9"Amber Screen
- ☐ Mono or Color Graphic Card
- ☐ Serial & Parallel Port
- ☐ 84 Key Soft Tough Key Board

$1155

BEST-88 PORTABLE $845

386 SYSTEM

- ☐ 16 MHZ 80386 CPU 8/16MHZ
- ☐ 20 MHZ (Option)
- ☐ 80287 & 80387 Socket
- ☐ 1 M RAM
- ☐ One 32-bit, Five 16-bit, Two 8-bit Expansion Slots
- ☐ 1.2 M Floppy Drive
- ☐ WA2 or NCL Control Card
- ☐ 3.5" Drive (Option)
- ☐ Tower Chassis

$1995

286 BABY MOTHER BOARD	
10 MHZ	$265
12 MHZ	$295
8088 Mother Board	$95
Mono Graphic	$55
Color Graphic	$55
80286 I/O Card	$59
200 W Power Supply	$79
150 W Power Supply	$55
Mono Monitor	$79

EGA PLUS 640 x 480 (Paradise Compatible)	$139
PORTABLE CASE	
9" Dual Amber Monitor 200 W Power Supply	$359
9"Dual Amber Monitor 150 W Power Supply	$339
LCD CASE	
640 x 200 Dots	$549
640 x 400 Dots	$699

BEST-286 LAPTOP

- ☐ 10 MHZ 0 Wait (12 MHZ Optional)
- ☐ 512 K RAM
- ☐ Two 1.44 M Floppy Drive
- ☐ Back Light Supertwist LCD
- ☐ 80 x 25, 640 x 400 Pixels Graphics
- ☐ Enhance 86-Key Key Board
- ☐ One Parallel Two Serial Port
- ☐ Dimension 16" x 11" x 3.5"
- ☐ RGB / Monochrome Monitor Port
- ☐ AC Adaptor
- ☐ 1.5 Hours Rechargeable Battery (Optional)
- ☐ 20 MB or 40 MB Hard Disk (Optional)
- ☐ Weight only 11 Lbs.

$1950

DEALER CALL FOR DISCOUNT

BEST *COMPUTER INC.*
5017 Telegraph Road
Los Angeles, CA 90022

Tel: (213) 265-0900
Tech: (213) 265-0300
Fax: (213) 265-4234
Toll: (800) 634-7920
Outside Cal.

MON - SAT 9:00 - 6:00 PACIFIC TIME
PRICE ARE SUBJECT TO CHANGE WITHOUT NOTICE

Circle 25 on Reader Service Card
(DEALERS: 26)

Credit Card Purchase Subject to Service Charge.

FIRST IMPRESSIONS ■ Rich Malloy

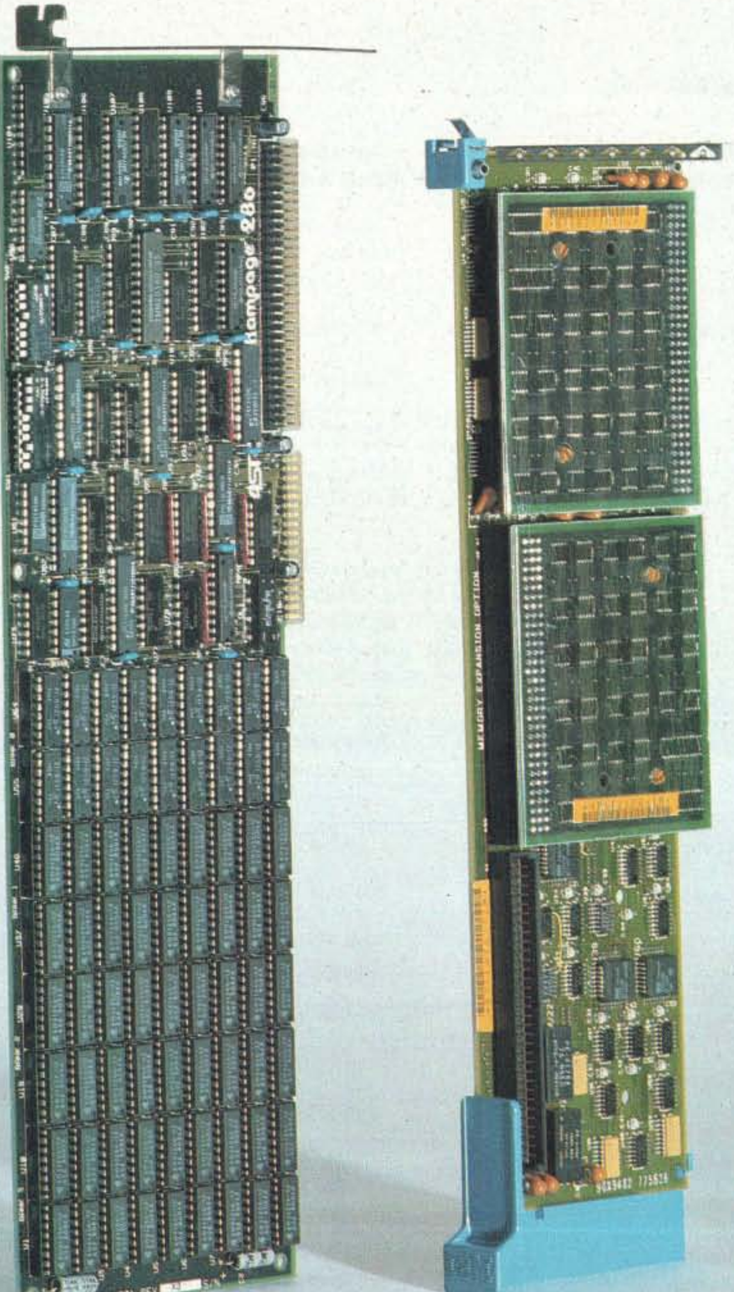
MEMORY BOARD ROUNDUP

How PS/2 memory boards stack up against those for the PC, XT, and AT systems

One of the first questions that comes to mind when you're trying to evaluate the IBM Micro Channel architecture (MCA) is: How many boards are available for it? That's a question we asked ourselves recently, and we figured that now is as good a time as any to find out.

Of course, if we wanted to count all types of boards, we'd probably have to devote a whole issue of the magazine to the task. Instead, we narrowed our search to one segment of the add-in board market. And for a control group, we looked at the corresponding group of boards avail-

continued



MEMORY BOARDS FOR THE PC/XT/AT SYSTEMS

Company	Board	Host system	Bus type (bits)	Standard memory (bytes)	Maximum memory (bytes)
American Micronics	Elephant-5	AT	16	0K	5M
AST Research	Advantage[1,3]	AT	16	128K	1.5M
	RAMpage 286	AT	16	512K	2M
	RAMpage Plus 286	AT	16	512K	8M
	RAMvantage!	AT	16	128K	3M
Boca Research	BocaRAM/AT	AT	16	0K	4M
	BocaRAM/XT	PC/XT/AT	8	0K	2M
	TophAT	AT	16	128K	128K
Cheetah International	Combo	AT	16	0K	1.5M
Club AT	Maxi-Magic EMS	PC/XT	8	0K	2M
Comark	CAT C-RAM	AT	16	0K	1M
	CAT D-RAM	AT	16	0K	4M
Computer Elektronik	XDrive	AT	16	1M	1M
DigiBoard	DigiRAM/3MB	AT	16	N/A	3M
Everex Systems	Magic Card 1[1,2]	PC/XT/AT	8	0K	384K
	RAM 10000	AT	16	0K	10M
	RAM 3000 Deluxe	AT	16	0K	3M
	Mini Magic Card	PC/XT/AT	8	0K	576K
IDEAssociates	IDEAmax 30	PC/XT/AT	8	0K	8M
	Supermax 30[1,3]	PC/XT/AT	8	0K	8M
	Supermax/EMS[1,3]	AT	16	0K	16M
Intel	Above Board 286	PC/XT/AT	16	512K	2M
Micron Technology	1-Mb EMS Board	AT	16	1M	4M
	2-/4-Mb Extended Memory DIP Board	AT	16	2M	4M
	2-Mb Expanded Memory Board	PC/XT/AT	8	2M	2M
	4-Mb Extended Memory ZIP Board	AT	16	4M	4M
	6-/16-Mb Extended Memory DIP Board	AT	16	6M	16M
	PC/AT & compatibles 2-/4-Mb EMS Board	AT	16	2M	4M
Monolithic Systems	JustRAM/AT16	AT	16	2M	16M
	JustRAM/ATX	AT	16	2M	16M
	JustRAM/ATZ	AT	16	2M	8M
Newer Technology	attention!	AT	16	0K	4M
PC Technologies	286 RAMRacer	PC/XT/AT	8	0K	2M
	RAMPartner	AT	16	0K	2M
Profit Systems	Elite 16[1,2]	AT	16	512K	16M
STB Systems	Memory Companion/PC	PC/XT/AT	8	2M	2M
	Rio Plus II[1,2]	PC/XT/AT	8	64K	576K
Suntek	MemoPlus AT	AT	N/A	0K	2M
Tall Tree Systems	JRAM AT2	AT	16	0K	2M
	JRAM AT4	AT	16	0K	8M
Tecmar	Captain 286[1,2]	AT	16	128K	16M
Veritek	Low Profile Mega Mem	AT	16	0K	2M

---

[1] Parallel port
[2] Serial port
[3] Two serial ports

Chip size (bits)	Chip speed (ns)	Memory Standard				Price	Warranty period (years)	Comments
		Extended memory	EMS	EEMS	EMS 4.0			
256K	60–120	●	●	○	○	$439	2	EMS 4.0 supported by software.
256K	120	●	○	○	○	$399	2	Optional piggyback board supports 3 megabytes.
256K	100, 120	●	●	●	○	$695	2	Includes software driver for EMS 4.0.
256K, 1M SIMMS	85, 100, 120	●	●	●	○	$895	2	Includes software driver for EMS 4.0.
64K, 256K	120	●	○	○	○	$445	2	
256K	120, 150	●	●	○	○	$225	2	Includes software driver for EMS 4.0.
256K	150	○	●	○	○	$175	2	Includes software for EMS 4.0.
64K	150	○	○	○	○	$165	2	
256K	60	●	○	○	○	$395	1	Runs at zero wait states in protected mode.
256K	100	●	●	○	●	$89	1	
256K	120	●	○	○	○	$235	1	Can support up to 1 megabyte of NMOS, CMOS, and EPROM devices; has on-board lithium cell rated at 2 amps.
256K	100	●	○	○	○	$310	1	
Static RAM CMOS	120	○	○	○	○	$1090	2	
64K	120	●	○	○	○	$319	1	
64K, 256K	150	○	○	○	○	$199	1	
256K	150	●	○	○	●	$399	1	
256K	150	●	○	○	●	$228	1	
64K, 256K	150	○	○	○	○	$99	N/A	
256K, 1M SIMMS	120	○	●	○	●	$275	1	
256K, 1M SIMMS	120	○	●	○	●	$395	1	
256K, 1M SIMMS	120	●	●	○	○	$425	1	
256K	120, 150	●	○	○	●	$645	5	Version of board available with serial and parallel ports.
256K	100	●	●	●	●	$895	2	Full 16-bit data transfers at all speeds; mappable backfill for multitasking; RAM disk and print spooler software included.
256K	100	●	○	○	○	$1345	2	Includes RAM disk and print spooler software.
256K	150	●	○	○	○	N/A	2	Includes diagnostics, RAM disk, and print spooler.
N/A	N/A	●	○	○	○	N/A	2	Includes diagnostics, RAM disk, and print spooler.
1M	100	●	○	○	○	N/A	2	Includes diagnostics, RAM disk, and print spooler.
256K	N/A	○	●	○	○	N/A	2	Mappable back to support multitasking applications; full 16-bit data transfers at all speeds; includes RAM disk and print spooler.
1M	100	●	●	○	○	$1888	5	Includes software for EMS 4.0.
1M	100	●	○	○	○	$1885	5	Includes disk-cache software.
1M	100	●	●	○	○	$1721	5	Includes software drivers for EMS, RAM disk, and disk cache.
256K	120	●	○	○	○	$250	1	Includes software drivers for RAM disk and print spooler; optional EMS in software.
256K	150	○	●	●	○	$595	2	Includes 512K-byte daughtercard; optional 80287 math coprocessor.
256K	150	○	●	●	○	$250	2	
256K, 1M SIMMS	120	●	○	○	●	$695	5	
64K, 256K	120	○	●	○	○	$1595	2	
64K, 256K	120	○	○	○	○	$269	2	
256K	120	●	●	○	○	$135	1	Includes software for EMS 4.0, RAM disk, and print spooler.
256K	120	●	●	○	○	$349	N/A	
1M	120	●	●	○	○	$399	1	
1M SIMMS	100	●	●	○	○	$575	2	
256K	150	●	○	○	○	$279	2	

● Yes ○ No N/A=Not available

MEMORY BOARDS FOR THE PS/2 MCA SYSTEMS

Company	Board	PS/2 model	Bus type (bits)	Standard memory (bytes)	Maximum memory (megabytes)
AST Research	Advantage 2/386	70, 80	32	1M	8
	Advantage/2	50, 60	16	0K	8
	RAMpage Plus/MC	50, 60	16	0K	8
	RAMpage/2-286	50, 60	16	0K	2
Boca Research	BocaRAM 50/60	50, 60	16	0K	4
Chrislin Industries	CI-SYS2-56	50, 60	16	2M	8
CMS Enhancements	MC-8000	50, 60	16	0K	8
Computer Elektronik	Micro Four	50, 60	16	0K	4
Everex Systems	RAM II 2000	50, 60	16	0K	2
	RAM II 4000	50, 60	16	0K	4
IBM	80286 Expanded Memory Adapter/A	50, 60	16	2M	2
	80286 Memory Expansion Kit	50, 60	16	512K	2
	80386 Memory Expansion Option	70, 80	32	2M	6
IDEAssociates	IDEAmax/MC	50, 60	16	0K	12
	IDEA Supermax/MC[1]	50, 60	16	0K	8
Intel	Above Board/2	50, 60	16	0K	2
Monolithic Systems	JustRAM/MC8	50, 60, 70, 80	16	2M	8
Orchid Technology	RamQuest Extra[1]	50, 60, 70, 80	16	0K	8
	RamQuest II	50, 60	16	1M	2
Profit Systems	Elite 16/2	50, 60, 70, 80	16	512K	16
Quadram	QuadMEG PS/Q	50, 60	16	512K	4
STB Systems	RapidRAM 2	50, 60	16	2M	2
	RapidRAM 2/8	50, 60	16	2M	8
Tecmar	MicroRAM 50/60	50, 60	16	0K	8
	MicroRAM AD	50, 60, 70, 80	16	0K	8

---

[1] Has two serial ports.

able for the industry-standard PC, XT, and AT systems.

Next, we had to decide which segment of the market to concentrate on. We could look at graphics boards, but since the PS/2s have graphics on the motherboard, there would naturally be a smaller number of graphics boards available for these systems. The same would apply to multifunction cards, since the PS/2s already have a parallel and serial port.

We could do a roundup of modems, but that's a rather specialized area. A much more basic need is memory, a resource that we never seem to have enough of. Unless you have one of the new systems that can accommodate up to 8 megabytes on the motherboard, chances are you'll need to buy a memory board at some point.

To get a more or less complete listing

Chip size (bits)	Chip speed (ns)	Memory Standard			Price	Warranty period (years)	Comments
		Extended memory	EMS	EMS 4.0			
256K, 1M SIMMS	85	●	○	○	$1395	2	
256K, 1M SIMMS	150	●	○	○	$345	2	
256K, 1M SIMMS	100	●	○	●	$595	2	Optional serial or serial/parallel port piggyback card available; includes software driver for EMS 4.0.
256K, SIMMS	120	●	○	○	$495	2	
1M	120	●	○	○	$295	2	Includes EMS-emulation software.
1M	100	●	○	●	$975	5	4K-byte user-programmable PROM.
256K, 1M SIMMS	120	●	○	●	$395	N/A	
1M	100, 120, 80	●	○	○	$399	2	
1M	120	●	○	●	$399	1	
1M	120	●	○	●	$499	1	
256K	120	●	○	○	$1460	1	Requires and supports device drivers resident within the 3270 workstation program and operates as contiguous memory with OS/2.
512K	150	●	○	○	$630	1	The $165 expansion kit includes 512K bytes to increase memory on option.
256K	80	●	○	○	$1695	1	The $1295 expansion kit includes 2 megabytes; two kits can be added to board to get maximum memory.
256K, 1M SIMMS	120	●	●	○	$395	1	
256K, 1M SIMMS	120	●	●	○	$545	1	
256K, SIMMS	100, 120	●	○	●	$445	5	Includes RAM disk and print spooler software.
1M	100	●	●	○	$1888	5	
256K, 1M	100, 120	●	●	○	$599	4	
256K	100, 120	●	●	○	$849	4	
256K, 1M SIMMS	120	●	○	●	$595	5	
256K, 1M	120	●	○	●	$545	1	Uses SIMM memory; includes RAM disk and print spooler software.
1M	100	●	○	●	$1595	2	10-MHz zero-wait state rapid MAP utility to increase software performance.
1M	100	●	●	○	$1695	2	
1M	100	●	○	●	$350	2	Optional dual serial/parallel adapter; uses SIMM chips.
1M	100	●	○	●	$445	N/A	Optional I/O modules with two serial ports or one parallel and one serial port.

● Yes ○ No N/A=Not available

of available memory cards for both PS/2 MCA systems and PC, XT, and AT systems, we enlisted the help of our McGraw-Hill sister company, Datapro Research. Datapro publishes the *Datapro Reports on Microcomputers*, which continuously keep track of microcomputer systems, peripherals, and software.

By combining our information resources with those of Datapro, we came up with a total of 25 boards available for the PS/2s and 42 memory boards for the PC, XT, and AT systems. As you might expect, there are more boards available for the PC, XT, and AT systems—but not that many more. ■

Rich Malloy is the associate managing editor of BYTE's news and technology section. He can be reached on BIX as "rmalloy."

Company Information

American Micronics, Inc.
17811 Skypark Cir., Suite H
Irvine, CA 92714
(714) 261-2428
Inquiry 866.

AST Research, Inc.
2121 Alton Ave.
Irvine, CA 92714
(714) 863-1333
Inquiry 867.

Boca Research, Inc.
6401 Congress Ave.
Boca Raton, FL 33487
(407) 997-6227
Inquiry 868.

Cheetah International, Inc.
107 Community Blvd., Suite 5
Longview, TX 75602
(800) 243-3824
Inquiry 869.

Chrislin Industries
P.O. Box FF
Canovanas, PR 00629
(800) 468-0736; in Puerto Rico,
(809) 876-5205
Inquiry 870.

Club AT, Inc.
46707 Fremont Blvd.
Fremont, CA 94539
(415) 490-2201
Inquiry 871.

CMS Enhancements, Inc.
1370 Valencia Ave.
Tustin, CA 92680
(714) 259-9555
Inquiry 872.

Comark Corp.
93 West St.
Medfield, MA 02052
(617) 359-8161
Inquiry 873.

Computer Elektronik Infosys
Trade Ventures International
512-A Herndon Pkwy.
Herndon, VA 22070
(703) 435-3800
Inquiry 874.

DigiBoard
6751 Oxford St.
St. Louis Park, MN 55426
(612) 922-8055
Inquiry 875.

Everex Systems, Inc.
48431 Milmont Dr.
Fremont, CA 94538
(415) 498-1111
Inquiry 876.

IBM Corp.
Old Orchard Rd.
Armonk, NY 10504
(800) 426-2468
Inquiry 877.

IDEAssociates, Inc.
29 Dunham Rd.
Billerica, MA 01821
(617) 663-6878
Inquiry 878.

Intel Corp.
5200 Northeast
Elam Young Pkwy.
Portland, OR 97124
(800) 538-3373
Inquiry 879.

Micron Technology, Inc.
2805 East Columbia Rd.
Boise, ID 83706
(208) 383-4000
Inquiry 880.

Monolithic Systems Corp.
84 Inverness Cir. E
Englewood, CO 80112
(303) 790-7400
Inquiry 881.

Newer Technology
1117 South Rock Rd., Suite 4
Wichita, KS 67207
(316) 685-4904
Inquiry 882.

Orchid Technology
45365 Northfort Loop W
Fremont, CA 94538
(415) 683-0300
Inquiry 426.

PC Technologies, Inc.
704 Airport Blvd.
P.O. Box 2090
Ann Arbor, MI 48106
(313) 996-9690
Inquiry 427.

Profit Systems, Inc.
30150 Telegraph Rd.
Birmingham, MI 48010
(313) 647-5010
Inquiry 428.

Quadram Corp.
One Quad Way
Norcross, GA 30093
(404) 564-5566
Inquiry 429.

STB Systems, Inc.
1651 North Glenville Rd.,
Suite 210
Richardson, TX 75081
(214) 234-8750
Inquiry 430.

Suntek Information
Systems, Inc.
5369 Randall Place
Fremont, CA 94538
(415) 657-0567
Inquiry 431.

Tall Tree Systems
2585 East Bayshore Rd.
Palo Alto, CA 94302
(415) 493-1980
Inquiry 432.

Tecmar, Inc.
6225 Cochran Rd.
Solon, OH 44129
(216) 349-0600
Inquiry 433.

Veritek
1320–11 Grand Ave.
San Marcos, CA 92069
(619) 744-2313
Inquiry 434.

INCLUDES HAYES® COMPATIBLE MODEM!

PC voice mail, now only $199.

Watson®, hailed by one reviewer as "the premier voice mail station" at $498, is an even better value at $199. Watson eliminates telephone tag and gives you big-system features like auto speed-dial, auto answer, message forwarding, and built-in 300/1200 bps modem. For an ear-opening business applications demo, call **1 (800) 6-WATSON** (in Mass., (508) 651-2186). To order, call **1 (800) 533-6120** (in Mass., (508) 655-6066). Credit Cards Accepted.

Watson®
Natural MicroSystems Corporation

Circle 155 on Reader Service Card

Create a 3.5″ Micro Diskette with unlimited protection against a hostile world.

You're covered. BASF molds the rigid plastic jacket of its 3.5″ Micro Diskette to its own specifications, providing unsurpassed protection for the flexible disk within. Call 800-343-4600 for the name of your nearest supplier.

The Spirit of Innovation.

Circle 22 on Reader Service Card

BASF

California FREEWARE

Public Domain and Shareware for IBM™ and Compatibles*. DOS™ 2.1 o

ADULTS ONLY

☐ **ADULTS ONLY/1 (147)** - German made, great animated graphics. CGA required.

☐ **X-RATED PRINTMASTER (149)** - X-Rated graphics for Printmaster Plus.

☐ **X-RATED PRINTSHOP (150)** - X-Rated graphics for Printshop.

☐ **ASTRO-[bleep] (297)** - Dirty arcade game. CGA required.

☐ **NASTY GIRL (435)** - The name says it all... CGA required.

☐ **MAXINE (497)** - Must see... CGA req.

☐ **IN-OUT (555)** - Must see...CGA req. **HOT.**

☐ **ON-TOP (556)** - Must see...CGA req. **HOT.**

☐ **GET LUCKY (647)** - Multi-faceted adult oriented package. **NEW...**

ACCT/BUSINESS

☐ **EZ-FORMS Rev. D15 (66)** - Menu driven forms generator, misc. skeleton forms.

☐ **EASY PROJECT V2.5 (440)** - Complete project management system. Excellent.

☐ **REAL ESTATE ANALYST (83)** - Menu driven, mortgages, interest, etc.

☐ **FASTBUCKS V3.1 (191)** - Menu-driven home finance package. Easy to use.

☐ **PFROI (Portfolio Mgr.) V2.3k (87)** - Stocks, bonds, options,etc. Enables investor to manage their portfolio. **NEW...**

☐ **CK V3.16 (79)** - Full featured checkbook program with various reports. **NEW...**

☐ **BUSINESS LETTERS (303 & 304)** - (2 disk set) 650 business letters to fit all your needs. Edit with any word processor.

☐ **IN CONTROL V2.645 (174 & 175)** - (2 disk set) The ultimate prospect / client / customer tracking system. Hard drive req.

☐ **MR. BILL V3.27 (311 & 312)** - (2 disk set) Time & billing package; costs, credits, reports, audit trail, etc. **NEW...**

☐ **SLICWORKS V1.0 (321)** - Framework clone. Integrated database, spreadsheet, word processor, & communications.

☐ **EXPRESSGRAPH (457)** - Business graphing program; display in 10 different formats, & print out. Does line, bar, pie graphs, etc.

☐ **FLODRAW V1.00 (542 & 543)** - Produces flowcharts, organizational charts, system diagrams, etc. CGA required.

☐ **PRO PC-ACCT SYSTEM V3.0 (526)** - Fully integrated G/L, A/R, A/P. Menu driven, on-screen help,unlimited accounts, time & billing, inventory, invoices, checks & more.

☐ **LANDLORD V2.01 (585)** - A fast & easy rental management system. Does credits, debits, reports & more. Requires hard drive.

☐ **LEGAL FORMS & LETTERS (611)** - Over 100 different types. Word processor req.

☐ **MANAGEMENT TOOLS (643)** - 10 programs designed for management & supervisors; a mini-management course! **NEW...**

COMMUNICATIONS

☐ **RBBS BULLETIN BOARD V16.1A (613 - 616)** - (4 disk set) Turn your computer into a RBBS. Industry standard. **NEW...**

☐ **QMODEM V3.1 (293 & 294)** - (2 disk set) Full featured modem program. 200 number dialing directory, etc.

☐ **PROCOMM PLUS TEST DRIVE V1.1 (504)** Menu driven modem program with all the features; still one of the best. **NEW...**

DATABASE

☐ **FILE EXPRESS V4.22 (33 & 34)** - (2 disk set) Menu driven, easy to use database for storing any type of information. **NEW...**

☐ **WAMPUM V3.2B (37 & 38)** - (2 disk set) Menu driven dBase III clone. Knowledge of dBase III suggested. Latest version.

☐ **PC-FILE + V2.0 (493 - 495)**- (3 disk set) Full-featured database; help screens, menus, macros. Hard drive required.

EDUCATION

☐ **COMPOSER (3)** - Create, save, edit, play, & print your music. Nice...

☐ **LETTERFALL V1.1 (119)** - Improve your touch typing skills; 16 levels.

☐ **BEGINNING SPANISH (121)** - Teaches vocabulary, phrases, etc. Basic required.

☐ **THE WORLD 3D (127)** - Display maps of the world. CGA required.

☐ **FUNNELS & BUCKETS V 2.0 (130)** - Great learning game; add, subtract, multiply, & divide. Ages 5 - 10.

☐ **MATH-WHIZ (188)** - Teaches various math operations. Ages 5 and up. You choose the level. Basic required.

☐ **AMY'S FIRST PRIMER (133)**- Alphabet, numbers, counting, shapes, matching, etc. Ages 4 - 8. CGA & Basic required.

☐ **PLAY 'N LEARN (624)** - Has 7 different games for kids up to 4 years old. **NEW...**

☐ **SPELLING BEE (138)** - Grades 1 - 12. CGA & Basic required.

☐ **ALGEBRA TUTOR V1.01 (577)** - Teaches various operations of algebra. Great! **NEW**

☐ **ANIMAL MATH/MOSAIC (181)** - Count objects & graphic learning tool. Ages 4 & up. CGA req.

EGA/VGA PROGRAMS

☐ **EGA RISK (216)** - The game of world domination. Superb graphics.

☐ **EGA UTILITIES/1 (260)** - EGA demos, change fonts, palette setting.

☐ **ALDO'S ADVENTURE (605)** - Watch out for falling barrel's! Super graphics.

☐ **VGA PALLETTE TOOL V3.01 (512)** - EGA View the 250,000 color pallette, set & save color attributes, have color stick for programs. VGA required.

☐ **VGA CAD V1.4 (584)** - Full-screen painting, graphics & screen design program to access the entire 256 color register. VGA monitor/card req.

GAMES

☐ **SLEUTH V4.1 (89)** - Murder my
tery game similar to the board gam
"CLUE".

☐ **BLACKJACK (95)** - Advanced blackjack gam
with tutor, multiple players. Great!

☐ **MONOPOLY V6.7 (106)** - Just like the boar
game, 2 to 4 players. CGA req.

☐ **TREASURE QUEST V1.1 (205)** - Former
known as DND. Perils galore. CGA req.

☐ **LAS VEGAS (116)** - Craps, Roullete, Poker,
more. CGA req., Basic on some.

☐ **3D CHESS V1.01 (215)** - Excellent ches
game. Switch between 2D & 3D.

☐ **SAM SPADE V1.0A (226)** - Great detectiv
game, with graphics. CGA req.

☐ **SUPER PINBALL (212)** - 5 different game
CGA required.

☐ **WORDPLAY (367)** - Wheel of Fortune clone
You provide the prizes. CGA req.

☐ **HANGMAN (91)** - 2 versions of the ever popu
lar game & learning tool. CGA req.

☐ **AGT (595 & 596)** - (2 disk set) - Create you
own adventure games. Nice...

☐ **MINIATURE GOLF (505)** - 18 hole golf cours
with graphics. CGA required.

☐ **PC-PRO GOLF V2.00 (667 & 668)** - (2 dis
set) - A graphic based golf game which you selec
your clubs, direction, etc. Nice graphics. CGA re

GRAPHICS

☐ **FINGERPAINT V2.0 (282)** - Pai
program; 6 fonts, 81 sizes . Use f
desktop publishing, slide-show
cartoon playing.

☐ **PRINTMASTER GRAPHICS / 1 (319)** - 3 libra
ies of graphics. (See below)

☐ **PRINTMASTER GRAPHICS / 2 (549)** - Ove
150 more graphics. (See below) **NEW**

☐ **PRINTMASTER GRAPHICS / 3 (550)** - Ove
130 more graphics. **NEW...**

#'s 319, 549, & 550 require Printmaster Plus

☐ **PRINTSHOP GRAPHICS / 1 (320)** - 3 more l
braries of graphics for Printshop.

☐ **PRINTSHOP GRAPHICS / 2 (589)** - Over 15
more graphics for Printshop. **NEW...**

☐ **PRINTSHOP GRAPHICS / 3 (590)** - Over 13
more graphics for Printshop. **NEW...**

#'s 320, 589, & 590 require Printshop.

☐ **PC-KEY-DRAW V3.33 (534-536)** - (3 disk se
- Combination CAD/paint program; for power
flexibility. CGA/EGA req.

☐ **DANCAD 3D V2.0E (424 & 425)** - (2 disk se
Advanced 2D/3D drafting program. Stereoscopi
3D wire frame animation. 640k & hard drive re
quired. **NEW...**

☐ **CITY DESK V6.0 (197)** - Desktop publishe
with graphics capability. Multiple fonts, headers
footers, indexing, etc.

☐ **PC-DRAFT II V3.20 (629)** - Painting, draftin
program. Produce clipart...

ONLY $2.99 Per Disk

Programs to meet all your computing needs. *New programs added DAILY.*

LANGUAGE

☐ **TURBO "C" TUTOR (489 & 490)** - (2 disk set) 14 lesson tutorial : learn to program in "C" language.

☐ **"C" LANGUAGE V2.1 (299 & 300)** - (2 disk set) Complete programming environment. Source, compiler, samples, etc.

NOVELTY

☐ **STRESS & SHRINK (74)** - Stress - stress test. Shrink - personality analysis.

☐ **HORSERACING (343)** - Handicapping for thoroughbreds. Menu driven, dasy to use.

☐ **ASTROL 95 (284)** - Astrology; read your own chart from stars, moon, etc.

☐ **LOTTO # GENERATOR V1.50 (159)** - Advanced techniques to win big $$$. Contains data from beginning to 9-3-88.

☐ **FREEWILL V1.0 (171)** - Valid WILLS for California. Easy to fill in.

☐ **BIORHYTHM (194)** - Calculate & print your own monthly charts.

☐ **TENANTS RIGHTS (196)** - The 'Bible' for California renters. **A MUST.**

☐ **AIRPLANES (398)** - Print paper airplanes, fold-em and let 'em fly. Basic req.

☐ **EDNA'S COOKBOOK V1.16 (566)** - Record, file, list & print recipes or prepare your own cookbook. **NEW...**

☐ **WEIGHT CONTROL (586)** - A variety of programs from a calorie counter to dieting principles. Get rid of unwanted inches!!!

☐ **G.I.F.T.S. (618)** - Various gift ideas for any occasion or person. **NEW...**

☐ **PC-BARTENDER V2.00 (619)** - Recipes for approx. 200 drinks. Search by drink names, ingredient, etc. **NEW...**

PRINTER UTILITIES

☐ **BRADFORD V2.04 (551)** - Produces high quality text on dot matrix printers; multiple fonts. Excellent program. **NEW...**

☐ **LASERJET FONTS/I (327)** - 30 + downloadable fonts for Laserjet Plus/II.

☐ **LASERJET FONTS / II (471 & 472)** - (2 disk set) More downloadable fonts for HP Laserjet Plus/II. Helvetica, Script, etc.

☐ **ON-SIDE (560)** - A sideways printing program. Choose from 7 different fonts. Epson or IBM-compatible printer req. **NEW**

SPREADSHEET

☐ **PC CALC + V 1.0 (537-539)** - (3 disk set) - Complete spreadsheet program. Excellent...Buttonware.

☐ **GOALSEEKER (558)** - A memory-resident program for your favorite spreadsheet. Define your result and what the variables are and it will do the rest...**NEW.**

☐ **QUBECALC V3.02 (591)** - A 3-D spreadsheet program; turn rows into columns & vice-versa, import Lotus files, 44 predefined functions, help screens, etc. **NEW...**

☐ **LOTUS 123 TUTOR (177)** - Beginning tutorial for Lotus 123. Various worksheets. Requires Lotus 123.

☐ **AS EASY AS V3.0 (302)** - Lotus clone. 52 column sheet, graphing, supports functions of 123, "WK1" files, etc.

☐ **LOTUS LEARNING SYSTEM (458)** - Tutorial that covers overview, command menu structure, etc. Lotus **NOT** req.

UTILITIES

☐ **VACCINE / FLU-SHOT (541)** - Various programs to fight against "virus" & "trojan horse" programs. **A must for ALL...**

☐ **DISK COMMANDO V2.0 (218 & 219)** - (2 disk set) Norton Advanced Utilities clone. Too many features to list.

☐ **SIM-CGA (220)** - Great for most programs that need color (CGA) to run.

☐ **DOS HELP FOR V3.3 (255)** - Help screen for DOS commands, functions & batch files at your fingertips. Excellent! **NEW**

☐ **DOS TUTORIAL V4.4 (256)** - Menu driven, learn to use your computer. **NEW**

☐ **BEGINNERS (257)** - The basics of using most public domain/shareware software.

☐ **LIST V6.2A (274)** - Best utility for viewing documentation or any ASCII file.

☐ **AUTOMENU V4.01 (280)** - Access programs, batch files, commands, etc.

☐ **POWERMENU V3.1 (419)** - Provides easy access to any application on your PC.

☐ **HOMEBASE V2.5 (528 - 530)** - (3 disk set) Great desktop organizer; editor/word processor, calendar/appt. book, calculator, cut & paste operations, & much more.

WORD PROCESSING

☐ **PC-OUTLINE V3.34 (7)** - Windowing outline editor/thought organizer. Great...

☐ **CATALIST V3.2 (163 & 164)** - (2 disk set) The ultimate mailing list manager. Super!

☐ **PC-WRITE V2.71 (9 & 10)** - (2 disk set) Full featured word processor; all the features of the expensive one's.

☐ **LETTERHEAD V1.1A (69)** - Create and print your own letterhead on letters and enveopes. IBM/Epson comp. printer req.

☐ **GALAXY V2.3 (11)** - Easy to use word processor; menus & quick keyboard commands. Lots of features.

☐ **WORDPERFECT MACROS (189)** - Contains over 80 macros for V5.0.

WHATS NEW?

☐ **MAXI-MAX (669)** - Over 65 macros & templates for Wordperfect V4.2.

☐ **THE NUTRITIONIST (670 & 671)** - (2 disk set) - Provides a means to evaluate foods & compare them to their needs.

☐ **FOOTBALL SCORECARD (672)** - Contains scores for more than 3700 regular season, playoff, & Superbowl games.

☐ **MANAGEMENT MENTOR (673)** - A self assessment inventory for managers allowing the user to evaluate his/her weaknesses in 12 management categories.

☐ **FORTUNE TELLER (675)** - Various programs for "fortune telling".

☐ **EGA-TREK (677)** - Fight the Klingons, Romulans, etc., in this excellent graphic adaptation of "Star Trek". EGA required.

☐ **EMPLOYEE MGMT. SYSTEM (688)** - Uses responses to questions to determine requirements to fill job positions. Excellent.

☐ **CYRUS (691)** - A 3-D chess game with excellent graphics. EGA required.

☐ **CUNNING FOOTBALL V1.0 (693)** - An interactive menu driven football game. Call your own plays (offense or defense), nice graphics. CGA required.

ORDER FORM

Please print disk numbers

___ ___ ___ ___ ___
___ ___ ___ ___ ___
___ ___ ___ ___ ___ ___ ___

NAME____________________
ADDRESS____________________
____
CITY__________ ST_____ ZIP_______
PHONE (_____)__________

3.5" media - $3.99 ea.

2 disk sets are 2 @ $2.99 each = $5.98.

We do not split sets.

# of disks____ @ $2.99 = ______
Calif. Sales Tax (6.5%) = ______
Shipping & Handling= 3.00

TOTAL = $ ===========

✓Payment Type: ☐ Check/MO ☐ VISA ☐ MC

________________ ___/___
Charge Number Expiration Date

____
Signature

Mail order form & payment to:

California FREEWARE
1466 Springline Dr., Dept. SP
Palmdale, CA 93550
(805) 273-0300
Hours: M-F 8AM-4PM PST

Call or write for free catalog with over ***700 disks***

* Software not guaranteed to work on all IBM compatibles. Call for disclaimer info.

BSP1088

VISA MasterCard MEMBER DIRECT MARKETING ASSOCIATION

Circle 245 on Reader Service Card

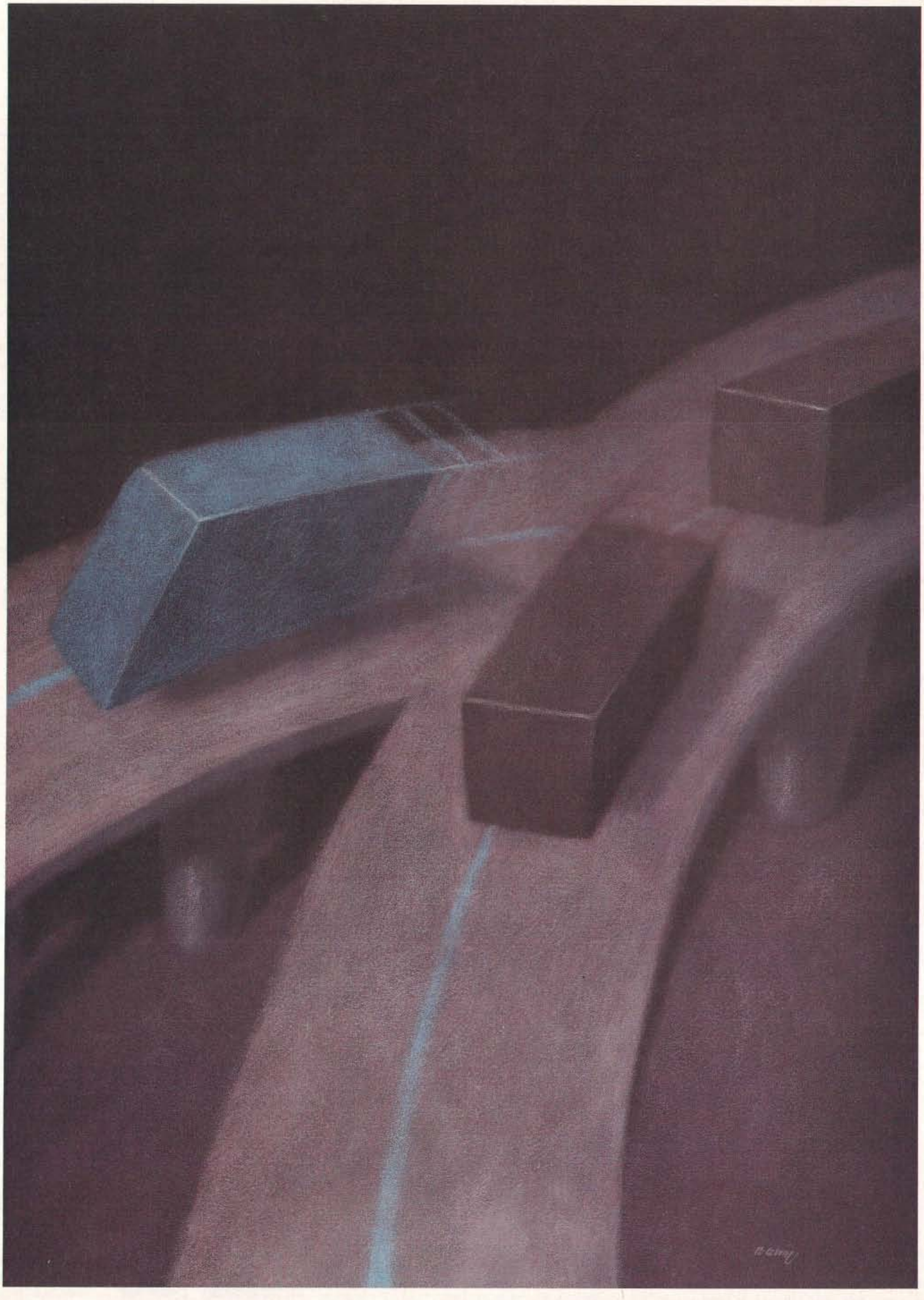


ILLUSTRATION: ROB COLVIN © 1988

The Micro Channel versus the AT Bus

IBM changed the rules with the PS/2's Micro Channel architecture, but a lot of AT fans aren't playing along. Should you?

Kerry Newcom

Shortly after IBM introduced the PS/2s in April 1987, it stopped making the IBM PC, XT, and all but one model of the AT. The PS/2 machines offered more performance and a new, modular design.

But the most radical change was the sharp break with the hardware bus standard for expansion cards that IBM had established in 1981. Except for the low-end PS/2 models, IBM's original PC bus design is gone, replaced by the Micro Channel architecture. The MCA offers the promise of better throughput and multiprocessing, though these features have taken longer to be exploited than was expected.

Had any other company introduced them, the PS/2s would have been hailed as innovative, clever, technically progressive, and destined to fail due to lack of IBM compatibility. But IBM's marketing muscle worked to ship more PS/2s in a shorter period than any other computer ever built. Other vendors are building MCA expansion boards or adopting the MCA bus in their latest computers. For example, Dell and Tandy recently announced computers featuring an MCA-compatible expansion bus.

Meanwhile, other vendors offer microcomputers using the AT bus, the industry standard established by IBM and now championed by industry giants like Compaq. A multitude of expansion cards are available for the AT bus, and clever designers have worked around some of its limitations while providing high-performance processing.

So which computer architecture is best for solving today's problems? The best way to answer that question is to tackle the technical merits of the AT bus and the Micro Channel head-on.

Where's the Standard?

If you want to compare the Micro Channel with the "industry-standard" AT bus, it's necessary to define the industry standard, and that's not as easy as it sounds. The original AT has evolved into several diverse high-end computers; to figure out where the industry standard is headed, it's best to look at its roots.

The Micro Channel and the AT bus are both extensions of the local processor bus; that is, they're processor-specific and defined by the processor's signals. The original PC bus resembled the 8088 processor. The AT bus expanded the capabilities of the PC bus, in the same way the 80286 processor expanded the capabilities of the 8088. If there ever was an industry-standard bus, it stopped with the IBM Model 339: This was IBM's last AT-bus machine and was based on an 8-MHz 80286 processor. The significant thing about this industry-standard bus is that timing and mechanical specifications were never published in the IBM AT *Technical Reference* manual.

When IBM failed to publish timing specifications for the AT, it forced every third-party manufacturer to derive the bus timing from the schematics—a design approach with some major pitfalls. The first pitfall is that there is no guarantee that what's in the schematics matches what's in the production units.

The second pitfall has to do with the fact that to remain competitive, every clone manufacturer wants its computer to have the highest performance. The easiest way to do this is to turn up the processor clock. As the clock speed increases, the design margin (i.e., the spare time that the bus has to complete an operation) decreases. If you increase the processor clock rate sufficiently, the design margin for cards built for the original AT disappears and the expansion cards begin to fail. Since the bus timings were derived from schematics, the exact margins are unknown.

At this point the manufacturer has a choice between a fast, low-cost product with potential reliability problems and a fast, costly product that will work reliably. The additional cost comes from the circuitry required to couple a high-speed processor with a slower system bus.

Most manufacturers opted for reliability and designed the AT bus to run at a slower speed than the processor. This approach maintains compatibility with existing third-party add-in cards. It also improves reliability but ignores the original need for speed. The only way to boost the computing power is to design a

continued

Table 1: *The signals for the AT bus and MCA bus compared. Note the additional signals for arbitration and control on the MCA bus.*

Signal type	AT bus	Micro Channel	Definition/comments
Processor	SA0 SA19 latched	A0-A31 unlatched	Address lines
	LA17 LA23 unlatched	MADE 24	
	D0-D15	D0-31	Data lines
	BALE	ADL	Address latch
		SBHE, S0, S1, M/-IO	Memory and I/O status
	SMEMW, MEMW		Memory and I/O enables derived from processor signals
	SMEMR, MEMR		
	IOR, IOW		
Memory	REFRESH	REFRESH	
	I/O CH CHCK	CHCK	Parity or serious system error
DMA/bus master control	DRQ0-3 5-7	-PREEMPT	DMA request
		ARB 0-3	
	DACK0-3 5-7	ARB/GNT	DMA acknowledge
	TC	TC	Terminal count
		BURST	
Interrupts	IRQ3-7, IRQ9-12, 14, 15	IRQ3-7, IRQ9-12, 14, 15	
	RESET	CHRESET	Reset
	MEM CS 16	CD DS 16	Control signals for 16-bit transfers
	I/O CS 16	DS 16 RTN	
Clock	OSC	OSC	14.3 MHz
AT-specific	0WS		Zero wait states
	CLK		8 MHz
	MASTER		Used to gain bus control
	AEN		Address enable
MCA-specific		CD SETUP(n)	
		CMD	
		CD SFDBK(n)	
		CD CHRDY(n)	
		CHRDYRTN	
		CD DS 32(n)	
		DS 32 RTN	
		TR 32	MC 32-bit bus masters
		BE0-3	Byte enable
Advanced memory		MMC	Matched memory cycle
		MMCR	
		MMC CMD	
Video		VSYNC, HSYNC, BLANK	
		P7-0, DCLK, ESYNC, EVIDEO, ED CLK	
Audio		AUDIO	
		AUDIO GND	

high-speed local memory bus that can keep pace with the processor. Fast static RAM (SRAM) or interleaved memory addressing is used to satisfy the speed requirements of the processor without wait states. Exotic support chips for numeric processing and other functions are added for additional processing power.

Just when manufacturers got their 80286 machines cranked to the max, Intel introduced the 80386. IBM kept quiet about its plans for the 80386. With no one to define a standard, the manufacturers took the worst possible action—they formed a committee.

In 1986 a representative committee of several manufacturers set out to define a standard 32-bit bus for the 80386, the Personal Computer Extended Technology (PCET) bus. To keep their 80386 designs secret, none of the major players joined the committee. When the first 80386-based machines were announced in the fall of 1986, the committee disbanded and no standard was established.

Customers could always hope for a de facto standard: A standard based on largest sales or a system board that was designed into the widest variety of 80386-based machines. But no single standard has emerged. While Compaq has the largest market share for 80386 computers, Intel sells an 80386 board of its own design to a large number of system integrators. Other popular computers are based on proprietary designs different from those of both Compaq and Intel.

So what is the industry-standard AT bus that this multibillion-dollar industry is based on? It definitely isn't the old AT bus: The resemblance of this bus to the ones inside computers now blazing away at 20 MHz and 25 MHz is only superficial. As long as a computer works with most of the popular add-in cards, the industry standard is just about anything a manufacturer defines it to be. The bigger the manufacturer, the more "standard" its standard.

To reach valid conclusions, the comparisons in this article are limited to 80386-based computers. This narrows the field to the PS/2 Models 70 and 80 (which have no AT-compatible slots) and the current crop of 80386 AT-bus computers.

Basic Bus Components

An 80386-based AT-bus computer has a 20- or 25-MHz 80386 processor, an 8-MHz system bus, one or two 32-bit proprietary slots (usually for processor memory), three to six 16-bit AT-style slots, and perhaps up to three 8-bit PC-

continued

RECEIVE A FREE SIVA 386 SYSTEM

(\$2995 VALUE)

for the Holidays*

with the purchase of Quality Hardware/Software Products.

See VNS America Corp. advertisements** in this issue or call

1-800-252-4212

VNS America Corp.

Suite 270, 910 Boston Post Road
Marlboro, Massachusetts 01752 U.S.A.
In Massachusetts 508-460-0016
FAX: 508-481-2218

*Offer good until December 31, 1988.

**See Advertisers Index for pages.

style slots. Table 1 shows the signals for a standard AT bus and the MCA bus.

The Micro Channel has 32 address and data lines, while the AT bus has 24 address and 16 data lines. AT-bus computers compensate for the smaller address range by using a local 32-bit address and data bus for processor memory. Both the Micro Channel and the proprietary 32-bit buses use fast SRAM to closely match the 80386's speed. This fast SRAM eliminates the need for processor wait states during operation; computers using it show dramatic speed improvements.

However, this type of memory is expensive. The compromise between performance versus price is that only high-end AT-bus computers (such as those from Compaq or Everex) and IBM's PS/2 Model 70 provide this type of RAM in a cache (32K to 256K bytes) that minimizes processor wait states. Despite the design differences, the performance of a top-end AT-bus PC and the top-end Micro Channel PC are quite similiar (see "IBM and Tandy: Same Channel, Same Plan for Growth," September BYTE).

That's the current situation. One thing to remember is that since there is a bigger market for the 32-bit Micro Channel than for the proprietary 32-bit buses, there should eventually be a larger choice of high-speed memory boards for the Micro Channel. With proprietary buses, the only choice of memory cards is what the manufacturer offers, and if you don't like that product you're out of luck. Proprietary or not, pricing will probably remain realistic, given the intense competition in the industry.

The MCA bus is unquestionably more difficult to design for than the AT bus. It takes more hardware to design an MCA card, because more features are required and card functions must be software-configurable. The AT bus has few requirements, and it provides decoded signals (e.g., MEMR/W, IOR/W) while the Micro Channel provides raw processor signals (e.g., S0, S1, SBHE, M/-IO).

Availability of decoded signals can simplify some of the card's logic, but you're limited by the speed of the bus decode circuitry. Raw processor signals give the add-in card designer more options: He can generate his own decode signals using expensive high-speed parts for performance or use slower, inexpensive parts to reduce costs in products where speed is not a factor. The flip side of this flexibility is that it increases the complexity of the design.

If it takes more logic to design a Micro Channel card, it's logical that MCA cards are going to cost more. How much more is probably a marketing question rather than a technical one. Current MCA add-in cards are priced 10 percent to 50 percent above their AT equivalents.

The Space Squeeze

One obvious difference between AT-bus cards and Micro Channel cards is size. MCA cards are 45 percent smaller than AT cards (see figure 1), and this real estate crunch poses all kinds of problems for designers. The smaller size of the MCA cards, combined with the required additional functions, means that most AT designs simply won't fit on an MCA card.

A few companies have designed application-specific ICs for the Micro Channel to reduce the number of ICs on an MCA card. Surface-mount ICs can also ease the space squeeze, but they increase manufacturing costs. Using similar technology, it will always be possible to cram more capabilities on an AT card than on an MCA card.

Improvements in design, competition, and market size should bring more designs to the Micro Channel and bring prices down. However, at this time, the AT bus still offers far more add-in card choices and configuration options. The additional circuitry required on an MCA card could keep the cost of simple functions higher on the Micro Channel than on the AT bus. The high-end AT cards already packed with circuits face an uphill battle in their migration to the Micro Channel, with the expected increase in cost.

Direct memory access is available on both buses, allowing high-speed data transfer between memory and I/O. However, it takes more hardware to support DMA on the MCA than on the AT bus. For example, the card must arbitrate for bus ownership, and the DMA levels are programmable in software. The benefits for the MCA can be significant.

The Micro Channel supports eight DMA devices, while the AT bus supports seven. In actual practice, DMA is usually limited to three channels on the AT bus because most DMA devices can't use four of the available channels. The reasons for this originate with the original PC bus design, which supports only three DMA channels (actually four, but one is used for memory refresh).

Most vendors design their cards to work with the PC bus, which lets them sell the card to both PC and AT owners. The problem here is that the card uses only a subset of the AT-bus functions and doesn't use the additional DMA channels at all. This crunch on DMA channels in the AT bus often leads to hardware conflicts and configuration problems. The MCA automatically resolves DMA conflicts and sets DMA priority in an elegant way through a combination of hardware and software. With eight DMA channels and a maximum of seven slots, it's unlikely that DMA conflicts will occur on the Micro Channel.

Burst-mode DMA is an idea borrowed from minicomputers and officially introduced to desktops through the MCA. It is available on the AT bus as block-mode DMA but is rarely used because it isn't well documented. Burst-mode DMA gives an I/O device uninterrupted access to the computer memory and results in a 16-bit transfer every 200 nanoseconds for data rates as high as 10 megabytes per second. In contrast, the maximum DMA rate on the AT bus is less than 1 megabyte per second. Burst-mode DMA is best used in an application where the I/O device has well-defined packets of information to transfer. It offers the potential

continued

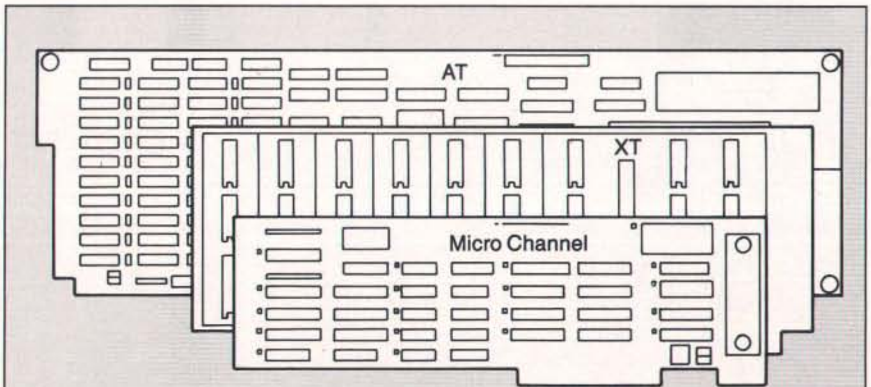
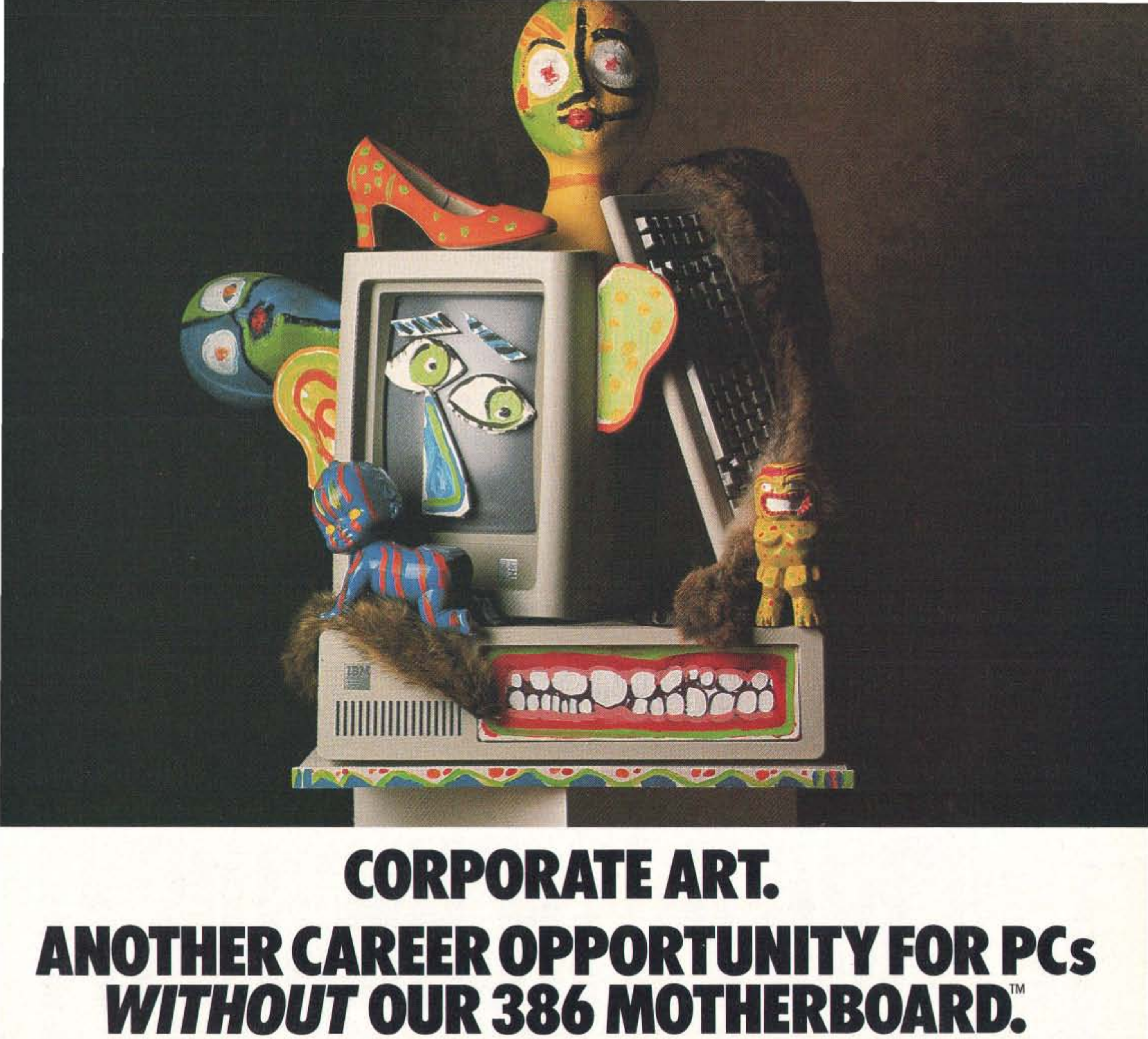


Figure 1: *The MCA card is smaller in area than either the XT or AT cards.*



CORPORATE ART.

ANOTHER CAREER OPPORTUNITY FOR PCs *WITHOUT* OUR 386 MOTHERBOARD.™

***With* Our MotherBoard, Your PC, XT or AT Can Run New OS/2 Releases!** If you'd rather keep your computer in the trenches than on a pedestal, get our 386 MotherBoard. Our Board will give your spreadsheet, complex CAD and graphics, and multitasking applications a boost to boast about. In fact, our line of MotherBoards accelerate your PC, PC/XT or PC/AT to speeds equal to the IBM PS2 Model 80. And faster. Because we've built in 1 Megabyte of high speed RAM and a 387 math coprocessor socket.

Accelerator Cards Have No Future. An accelerator card can only turn an obsolete computer into a faster obsolete computer. Our MotherBoards advance your computer into a new 386 system! They run OS/2, Windows/386, UNIX V and PC-MOS/386. For more power, you'll find 16-bit expansion slots that accommodate the latest I/O expansion cards. **Only our 386 MotherBoards give your PCs an unlimited future!**

The Critics Applaud! *PC Magazine* awarded our Board "The Editor's Choice" for 386 Replacement Boards. *PC World* called it "the Upgrade Product of the Year."

Technical Features ▪ 16 MHz 80386 ▪ 1 Megabyte of 100 nsec 4-way interleaved RAM ▪ PC/AT compatible I/O and BIOS for support of OS/2 ▪ Six 8-bit expansion slots ▪ two 16-bit expansion slots; four on 386 MotherBoard/AT ▪ One 32-bit expansion slot for up to 12 Megabytes of high speed memory ▪ Battery-powered clock calendar.

386 MotherBoard for the PC or PC/XT	$1695
386 MotherBoard for the PC/AT	$1795
386 MotherBoard/20 MHz for PC/AT	$2195
32-bit RAM Board (2 Mbyte installed; up to 10 Mbytes)	$1195
16 MHz 80387 math coprocessor	$695
16-bit combination hard disk/floppy disk controller	$245

Prices subject to change.

Power users like you will find our easy-to-install MotherBoards to be true works of art. For more information, call: **1 (800) 443-6284**. In New York: **(516) 434-1600**. All our products are available at your local computer dealer!

Hauppauge ComputerWorks, Inc.
175 Commerce Drive,
Hauppauge, New York 11788

Hauppauge!

Trademarks: IBM PC, XT, AT, PS2 and OS/2: IBM.
Intel 386: Intel Corp.; Windows/386: Microsoft Corp.

Circle 104 on Reader Service Card

for very high speed hard disks, but so far this potential has gone untapped.

Interrupts, Multiple Processors, and Video

For AT-bus cards, there are two unsolvable interrupt problems. The first problem occurs when two cards share the same interrupt line. Because interrupt signals on an AT bus are edge-triggered, once the interrupt pulse goes away the processor has no idea which card signaled for service. So each card on an AT bus must have a unique interrupt line. The second problem occurs when a program recognizes only one interrupt level yet needs to control two different cards.

The Micro Channel solves both problems by using a signal level rather than a signal edge to send an interrupt to the processor. Because each card drives the interrupt line until it is serviced by the processor, level interrupts can be shared by two or more cards. This also solves the software problem in the same stroke and lets a designer save time by setting up and testing identically configured MCA cards with one program.

Multiple processors can be used on the AT bus and on the Micro Channel. The bus master signal (-MASTER) coupled with the DMA lines permit multiple masters on the AT bus, and the preempt signal (-PREEMPT) coupled with the DMA lines permit multiple masters on the Micro Channel. Multiple processors hold promise for a number of applications. But the lack of an independent timing specification for the AT bus makes designing a reliable multiprocessor system impossible. The MCA solves this with a set of well-defined timing specifications, but there are problems that restrict its use, including a low bus bandwidth and limited operating system.

OS/2 is a multitasking, but not a *multiprocessor*, operating system. OS/2 lets one processor do many tasks, but it has no provision to split tasks among processors. Without a multiprocessor operating system, system resources cannot be shared. This restricts a second processor to I/O tasks. The big gains that could be achieved through parallel processing will have to wait for the next generation of hardware and software.

The Micro Channel defines a video bus; the AT bus doesn't. The absence of a video bus has had no effect on the AT graphics card business, as witnessed by the large number and variety of cards on the market. However, the MCA video bus has the potential of lowering video card costs: It provides easy access to the PS/2's video D/A converter, and it also should help to standardize monitor cabling and interface circuitry.

Finally, the MCA provides an audio line and audio ground not provided on the AT bus. This line won't let you get high-fidelity sound from your computer, but it has potential for digitized voice and other analog applications.

Software Configuration

The Micro Channel's Programmable Option Select allows software configuration of the expansion cards; with the AT bus, you must set switches or move jumpers to configure the card. POS is supposed to eliminate the hassles caused by configuration switches on AT cards. The jury is still out on whether it's really an advantage or a disadvantage because of its awkward implementation.

To achieve this level of functionality,

continued

80386 PC TECHNOLOGY

Because of the 80386 power and flexibility, Intel's newest microprocessor will cause revolutionary changes in both hardware and software markets well into the 1990s. ■ With CTR's new 210-page, *in-depth report,* Micro Managers, MIS Directors, and information technology firms will be prepared to make effective decisions regarding the 80386-based technology.

TOPICS COVERED IN DETAIL INCLUDE:
- Long-Term Investment Strategies
- 80386-Based PC Performance Issues
- Memory and Bus Architectures
- IBM PS/2 Models 70 and 80
- Compaq's Deskpro 386 Family
- 80386 Operating Systems
- Software Applications (386-Specific)
- Windows/386 and Multitasking
- Intel's Next Generation Chip: The 80486

Computer Technology Research Corp.
Tel: (516) 654-5398 Telex: 147195CTR CORP UD Fax: (516) 654-0331

Please Print
NAME ______
TITLE ______ PHONE ______ TELEX ______
COMPANY ______
ADDRESS ______
CITY/STATE/ZIP ______ COUNTRY ______
PLEASE SIGN HERE ______

Make check payable to: (U.S. Funds Only)
Computer Technology Research Corp. 180 East Main Street, Patchogue, New York 11772 U.S.A.
(Residents of New York State add applicable sales tax)

☐ Send me ______ Copy(s) of: 80386 PC TECHNOLOGY
Price: US $285.00 per copy
10% Discount for More Than One Copy
☐ Please send more information
☐ Payment Enclosed (Same Day Shipment Guaranteed)
☐ Send Reports and Bill me ☐ Credit Card
☐ American Express ☐ MasterCard ☐ Visa
Name (as it appears on card) ______
Acct. No. ______ Exp. Date ______
Sign Here ______

Circle 54 on Reader Service Card (DEALERS: 55)

ONE CHIP PLUS™

... "Makes building PS/2 boards simple"
Electronics

... "Quickens Micro Channel board design"
Electronic Products

... "Integrates all IBM PS/2 Micro Channel control needs"
Electronic Design

... "(CEC is) making it easier to soup up the PS/2"
BusinessWeek

... "Their chip is the most flexible we've seen"
Microprocessor Report

ONE CHIP PLUS is a complete Micro Channel interface on a chip, plus a development package that lets you build memory, I/O or multifunction boards in less time for less money.

ONE CHIP PLUS is a product of Capital Equipment Corp., a proven supplier of hardware and software for engineers. Call today. We can help you whether you're building one board or a million.

Literature 1 800 234 4CEC
Technical assistance (617) 273-1818

PS/2 and Micro Channel are trademarks of International Business Machines
ONE CHIP PLUS is a trademark of Capital Equipment Corp.
99 South Bedford Street, Burlington, MA. 01803

Circle 41 on Reader Service Card

A MESSAGE TO OUR SUBSCRIBERS

FROM TIME TO TIME we make the BYTE subscriber list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to the following address.

BYTE MAGAZINE
ATTN: SUBSCRIBER SERVICE
P.O. Box 7643
TEANECK, NJ 07666-9866

---

the Micro Channel requires software. A set of POS registers on Micro Channel cards eliminates the configuration switches but requires an adapter descriptor (.ADF) file that describes the card's characteristics to the POS software. Micro Channel boards can't be installed or removed without this .ADF file that defines their configuration. Installing a board takes about the same time on the AT as it does on the Micro Channel. With the AT card, you read the instructions, set the switches, and install the card. With the MCA card, you read the instructions, install the card, and run the configuration software. So far, so good.

Unfortunately, if you install and remove boards often, configuring a card for the Micro Channel can take much longer than for the AT. Consider the case where you want to share a card with someone. On an AT, you set the card up once, pop it out of your AT, place it in the other AT, and you're ready to run.

The same process on the Micro Channel is far more time-consuming. First, you configure your computer for the card when you install it, and then you configure the computer to forget the card when you remove it. Each time you reconfigure, you need to find your reference disk, and if you misplace the disk, you must reconfigure every board. If you don't reconfigure your Micro Channel computer after removing a card, the only error message is a decidedly unfriendly "165" code. No other message or instructions are provided. What's frustrating is that you know the computer knows what's missing, but it won't tell you anything or let you continue.

The configuration process gets even clumsier if a Micro Channel card has a hardware problem that causes a system board problem. On the AT bus, you simply pull out the questionable board and see if the problem goes away. When you pull the Micro Channel card out, you get the "165" error. You won't know if the problem went away until you reconfigure the computer. If the problem doesn't go away, you reinstall and reconfigure the board you just removed and start all over again with the next board. Software configuration is a good idea—IBM just fumbled the implementation.

Take Your Pick

So, which bus do you want for your next computer? The AT bus admittedly still enjoys a much wider selection of add-in cards. Most of the cards are priced lower than equivalent Micro Channel cards because they are simpler. Given equal technology, the larger AT-bus cards will always be able to carry more circuitry and therefore support more complex functions. The disadvantage of the AT bus is that it has run out of steam: It can't go any faster, and it has limited interrupt and DMA capability. AT-bus computers have managed to remain competitive, but at the expense of proprietary designs that lose some of the advantages of an open-architecture system.

The Micro Channel's main advantage is that it is a well-defined 32-bit standard. Mechanical, electrical, and timing parameters are carefully defined and readily available from IBM. This should lead to better, more reliable products. The Micro Channel was born a 32-bit standard, separate from the AT and free to break new ground. Unfortunately, AT hardware is not compatible with it.

Each bus offers a set of advantages and disadvantages. How you weigh them will determine which computer is best for you. If you own a lot of AT-bus cards, you have strong incentive to stick to an AT-bus computer. Aggravating the decision process is that while the MCA is a better design, it is not overwhelmingly better. Hopefully, IBM will clean up the POS software's act. The MCA has a lot of untapped potential, like high-speed DMA, video, and sound capabilities.

If you're just beginning to automate your office, there's not much risk in seeing if the MCA will live up to its promise. And if you plan to own your computers for the long haul, remember that the MCA offers a well-documented 32-bit bus standard—something AT-bus computers don't. ■

BIBLIOGRAPHY

Ciarcia, Steve. "The New Generation: Under the Covers." BYTE, August 1987.

Drummond, James R. "Three Bus Interface Designs for the PC." BYTE, *Inside the IBM PCs*, Fall 1987.

"First Impressions: The IBM PS/2 Computers." BYTE, June 1987.

Grehan, Richard. "The IBM PS/2 Model 50." BYTE, July 1987.

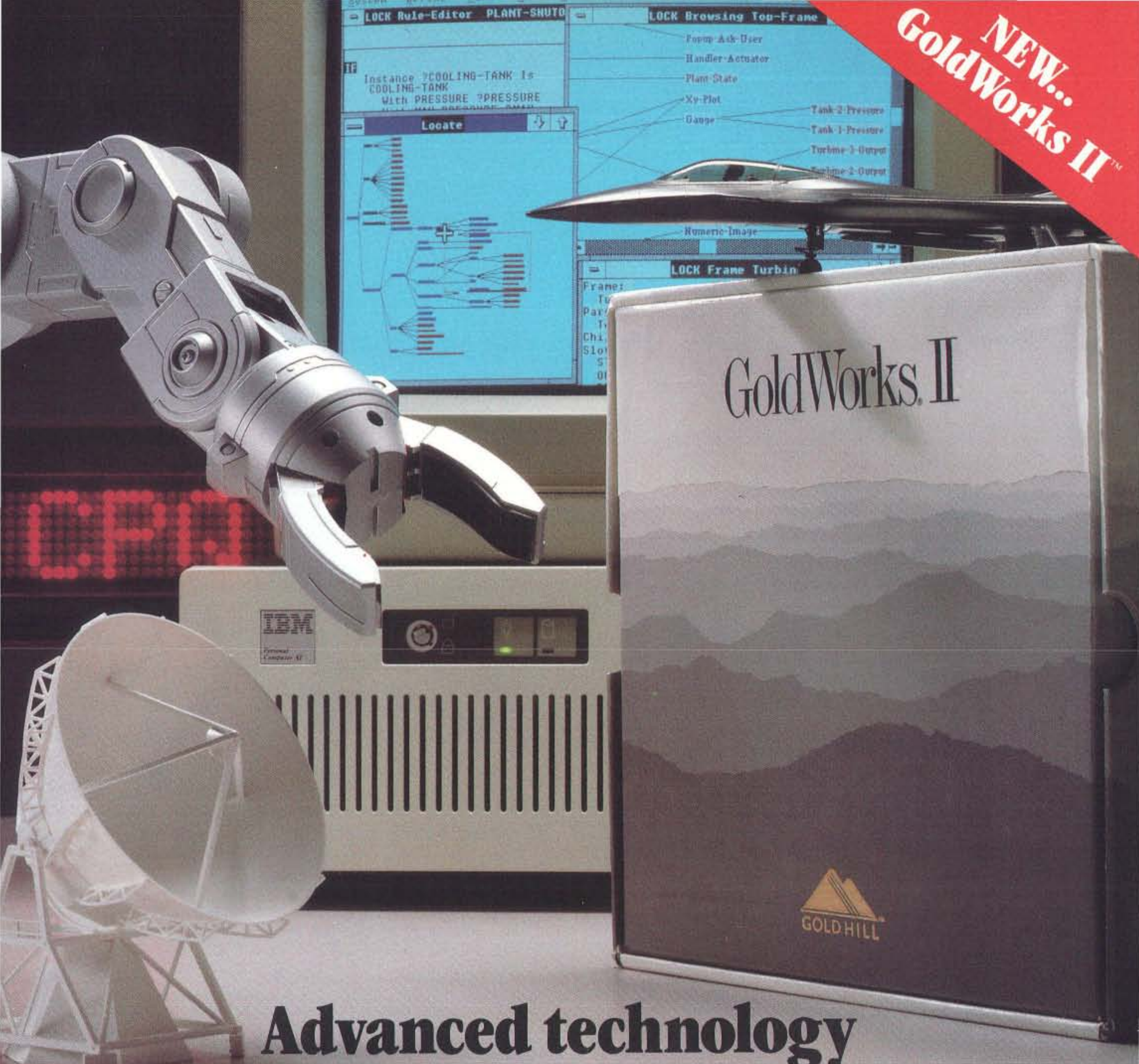
IBM Personal System/2 Model 50/60 Technical Reference. IBM part no. 68X2224.

IBM Personal System/2 Model 80 Technical Reference. IBM part no. 68X2256.

IBM Personal System/2 Trouble Shooting and Advanced Diagnostics. IBM part no. 68X2254.

Sheill, Jon. "The 32-bit Micro Channel." BYTE, *Inside the IBM PCs*, Fall 1987.

Kerry Newcom is president of Capital Equipment Corp. in Burlington, Massachusetts. He can be contacted on BIX c/o "editors."



Advanced technology for advanced applications.

The advanced technology of **GoldWorks II** is designed for the new generation of desktop computer systems. You get the proven performance and high productivity of Gold Hill's leading PC-based expert system development tool—plus dynamic graphics with Microsoft Windows.

So now you can tackle a broad range of knowledge-based problems on your PC class machine. Use the rich graphical environment to build intelligent interfaces. And integrate expert systems with conventional applications, spreadsheets, databases and other programming languages, including "C".

GoldWorks II is one of a family of superior Gold Hill products—including **GoldWorks AXLE**, a breakthrough tool that helps accelerate the development cycle, and **GoldWorks Runtime**, for expert system delivery on PCs. All backed by our uncompromising commitment to excellence in service, education and support.

Whether your expert system is in manufacturing, financial services, electronics, aerospace, or any other application—develop it with the most advanced PC-based development tool available—**GoldWorks II.**

And **GoldWorks II** will soon be available on the Sun and Apple Macintosh II.

To learn more, call or write Gold Hill today. And ask for your free copy of the Gold Hill Applications Portfolio. It describes numerous real world AI applications developed by some of our 12,000 users worldwide.

Gold Hill. The expert in AI.

Gold Hill Computers, Inc.
26 Landsdowne Street
Cambridge, MA 02139
Toll-free: 1-800-242-5477
In Mass.: (617) 621-3300

GOLD HILL®

Circle 96 on Reader Service Card

GOLD HILL and GoldWorks are registered trademarks, and GoldWorks II, GoldWorks AXLE and GoldWorks Runtime are trademarks of Gold Hill Computers, Inc. Microsoft and Windows are registered trademarks of Microsoft Corporation. Sun is a registered trademark of Sun Microsystems. Apple and Macintosh are registered trademarks of Apple Computers, Inc. Copyright 1988, Gold Hill Computers, Inc.

FLEXSCAN™ 9070S, PC Hi-Res That Looks Like a Million.

The FLEXSCAN 9070 Multiple Scan monitor is of course compatible with other multi-scans, but includes improvements that will give you the professional edge which is the mark of a good investment.

You can extend your multi-scan range from 20kHz to 50kHz in practical terms. This means that, at the 48-50 kHz range, you can make use of PC CAD/CAE capabilities at a resolution of up to 1024 dots × 768 lines.

The FLEXSCAN 9070 takes advantage of non-interlace high resolution signal as high as 1024 × 768 to provide you with a flicker free display at much brightness. You can also use the 9070 with IBM PS/2 or VGA compatible boards at a high resolution mode like 800×600 and 1024×768 (non-interlace).

The FLEXSCAN 9070 provides a 16-inch screen, large enough for CAD/CAE and 3-D projections, yet small enough to fit comfortably into your home work space.

1024 dots × 768 lines Graphics (Non-interlace)
AutoCAD

Also, for your convenience, all controls and switches, including the alternate video input, are located within easy reach on the front panel. The FLEXSCAN 9070 is compatible with a wide range of IBM, Apple, and other products, allow you to use all of today's popular programs---at a resolution that looks like a million.

FLEXSCAN™
MODEL 9070S

- IBM VGA(PS/2), 8514/A, PGC, EGA compatible and CAD/CAE use.
- Apple Mac. II and SuperMac Spectrum compatible
- Max. 1280 dots × 800 lines high resolution
- 1024 dots × 768 lines display on Non-Interlace signal delivers flicker-free high-res graphics
- 20kHz to 50kHz horizontal scan automatic adjustment. 50Hz to 80Hz vertical scan automatic adjustment
- 16 inch, 0.31mm dot pitch and newly developed XF(Extended Field) Gun to obtain both brightness and sharp focus.
- Front mounted controls including the input signal select switch between 2 video input.
- Selecting white or Amber displays colored application in shades of gray or amber
- Tilt-Swivel stand standard

Come see us at COMDEX
Booth #H8324

NANAO®

NANAO USA CORPORATION
23510 TELO AVE.,SUITE 5 TORRANCE, CA 90505
PHONE (213) 325-5202 FAX (213) 530-1679

Specifications are subject to change without notice.

APPLE, Macintosh II are registered trademarks of Apple Computers Inc. ARTIST, ARTIST 1 Plus, ARTIST 10, ARTIST 10/16 are trademarks of Control Systems Inc. IBM, IBM PC, XT, AT and PS/2 are registered trademarks of International Business Machines Corporation. SuperMac is a trademark of SuperMac Technology. SuperEGA HiRes, SuperVGA and SuperVGA HiRes are trademarks of Genoa System Corporation. Orchid Designer VGA, Orchid Designer VGA-2, TurboEGA and TurboVGA are trademarks of Orchid Technology. Paradise VGA Professional Card, Paradise VGA Plus Card and Autoswitch EGA are trademarks of Paradise Systems, Inc. Paradise Systems is a registered trademark of Paradise Systems, Inc. VEGA Deluxe and VEGA VGA are trademarks of Video-seven Inc. Metheus is a registered trademark of Metheus Corporation. Imagraph is a trademark of Imagraph Corporation. AutoCAD is a registered trademark of Autodesk Inc. GEM is a registered trademark of Digital Research Inc. Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation. SigmaVGA and SigmaEGA are trademarks of Sigma designs, Inc. FLEXSCAN is a trademark of NANAO CORPORATION. NANAO is a registered trademark of NANAO CORPORATION.

Circle 151 on Reader Service Card (DEALERS: 152)

KEEPING UP WITH THE CPU

Today's microprocessors are so fast that they can overwhelm system memory

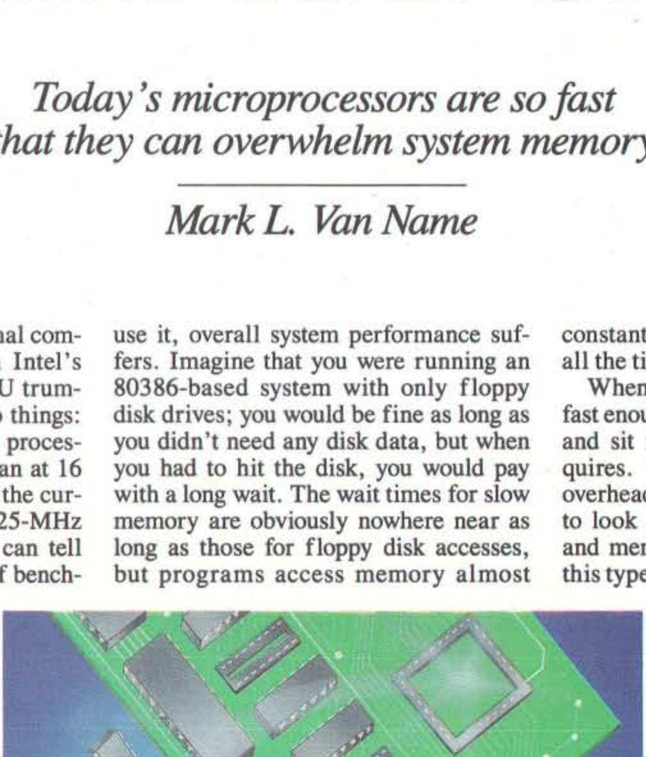
Mark L. Van Name

Most ads for personal computers based on Intel's 32-bit 80386 CPU trumpet the same two things: the price and the processor speed. First, such systems ran at 16 MHz, then at 20 MHz, and now the current performance leaders use 25-MHz 80386s. Unfortunately, as you can tell from a quick look at any table of benchmark times, processor speed is not the only thing that determines a system's overall performance. One other factor that is playing an increasingly important role in the performance of the new crop of high-speed 80386-based microcomputers is memory architecture.

As long as computers ran no faster than 8 or 10 MHz, their memory architecture was not an issue; normal dynamic RAM was fast enough. Most DRAM, however, cannot keep up with the newer, fast processors. While this problem is relatively new to microcomputers, minicomputer and mainframe designers have had to face it for some time.

The performance penalty for slow memory is similar to that for any other slow system component: Every time you use it, overall system performance suffers. Imagine that you were running an 80386-based system with only floppy disk drives; you would be fine as long as you didn't need any disk data, but when you had to hit the disk, you would pay with a long wait. The wait times for slow memory are obviously nowhere near as long as those for floppy disk accesses, but programs access memory almost constantly, so you pay the penalty almost all the time.

When it cannot get data from memory fast enough, the CPU has to stop working and sit idle until it gets the data it requires. To understand just how much overhead these waits can cost, you have to look at the timing of both processor and memory operations. You can apply this type of analysis to any processor, but I will stick with the 80386.



Processor Speed

For this discussion, the most important aspect of a processor's speed is its *cycle time*, the number of nanoseconds that it needs to complete its fastest instruction. You can compute a processor's cycle time by dividing 1 by the CPU's MHz rating; for example, a 16-MHz 80386 has a cycle time of 62.5 ns.

The cycle time alone is still not enough to determine how fast an 80386 can complete an operation. While some instructions, such as `NOP`, can complete in one cycle, most take two or more cycles. Simple register-to-register instructions, such as `CMP` (compare) and `ADD`, require two cycles. Some of the more complex instructions can take

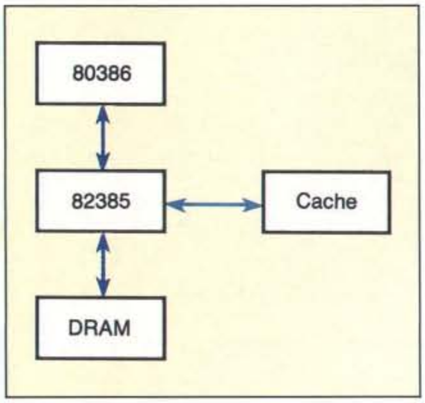
continued

ILLUSTRATION: ROBERT PASTERNAK © 1988

much longer, like the nine cycles that `MUL` (multiply), requires.

These times assume that the instructions are working on data that is entirely in registers. That is rarely the case in real applications. Usually, the input data has to come from memory, and often the processor has to send the result back to memory. When you add memory accesses, instructions take more cycles. An `ADD` instruction that has to get its input from memory goes from two cycles to either six cycles (if the answer goes into a register) or seven cycles (if the answer must go back to memory).

Also, those numbers assume that the system's memory can supply the required data fast enough to keep up with the processor. If it cannot, then the processor must wait for the data. Every cycle that the processor must wait is a *wait state*.



The Intel 82385 cache controller lets the 80386 run out of a small high-speed cache whenever possible; it accesses slower DRAM only when the memory the 80386 needs is not in the cache.

Memory Speed

So, when the 80386 needs to read or write to memory, how much time does the memory have to fulfill that request? Since typical 80386 memory accesses take two cycles, memory needs to respond in two times the processor's cycle time, or, for a 16-MHz 80386, 2 × 62.5 ns, or 125 ns. That number suggests that 100-ns DRAM or even 120-ns DRAM should do the job with no wait states.

Unfortunately, that's not how it works out. Memory manufacturers rate their chips by what they call *access time*. Access time is the time it takes those chips to supply information, assuming that they are ready to go. Each time the processor accesses DRAM, however, the memory has to recharge before the processor can use it again. While there is no simple formula for computing recharge time, for most DRAM chips it is only slightly less than the access time. For example, 100-ns DRAMs have a recharge time of about 90 ns.

This is still not quite the whole story in memory timing. DRAM has the disadvantage that systems periodically need to refresh it or lose the data it contains. While there seems to be no single fixed overhead for DRAM refresh, on most systems it adds a performance overhead of between 6 percent and 12 percent.

So, the actual speed of DRAM memory is its cycle time, the access time plus the recharge time; 100-ns DRAM has a cycle time of about 190 ns. In addition, there is the periodic refresh overhead.

The Problem

When you compare the cycle times of the DRAM in most personal computers to the cycle times of a 16-MHz 80386 (125 ns), you see the problem: 100-ns DRAM cannot keep up with the processor, and you have to pay the overhead of wait states. The situation only gets worse for 20-MHz and 25-MHz 80386s.

This is the heart of the major problem that the designers of today's high-speed microcomputers must face. The commercially available systems that have hit the market so far have tried to address this problem in one of the following six ways: live with it, or use faster DRAM, static RAM (SRAM), interleaved memory, paged memory, or caching.

What To Do?

The simplest answer is just to design the system to accommodate the wait states that accompany the commonly available 100-ns to 120-ns access time DRAMs. This technique is simple and inexpensive, but most system builders consider the speed loss prohibitive.

Another simple alternative is to use DRAM memory that can keep up with the 80386. This is as simple as the previous answer, and it avoids the wait states, but there are a few problems.

The first problem is the cost: DRAM chips get more expensive as they get faster.

The second problem is more severe: It would take incredibly fast DRAM to keep pace with today's high-speed 80386s without adding wait states. Even 80-ns DRAM chips have a cycle time of about 140 ns, which is already too slow for the 125-ns cycle time of a 16-MHz 80386. When you move to faster 80386s, the processor's memory-access time requirements become even more stringent: A 20-MHz 80386 has a cycle time of 100 ns, while a 25-MHz 80386 clocks an 80-ns cycle time. To support these chips, a system's DRAM would need access times of better than 60 ns and 50 ns, respectively. DRAM chips that can handle these speeds are not readily available in quantity—at any cost.

Even if you could get these chips, the system would still lose time for the periodic refreshes that DRAM requires.

Another way to get around the slow cycle time of DRAM is to use SRAM instead. The cycle time for SRAM is basically the same as the access time, so SRAM chips run faster than DRAM chips with the same rating. For example, the Intel 80386 hardware reference manual says that a 16-MHz 80386 can run with no wait states with 100-ns SRAM, while 100-ns DRAM would not be fast enough.

SRAM has one other advantage over DRAM: It does not need to be refreshed. By removing the approximately 6 percent to 12 percent DRAM refresh overhead, SRAM improves the overall system performance.

Dell Computer used SRAM in its first 80386-based system, the 16-MHz PC's Limited 386^{16}. Because of the 125-ns cycle time of the 16-MHz 80386, Dell was able to avoid wait states with 100-ns SRAM. Even with 100-ns SRAM, however, Dell's engineers found that the system could run with no wait states for only about the first megabyte of memory. After that, the system timing changed with the load on the bus, so that the 100-ns SRAM chips proved to be about 7 ns too slow. Dell employed some proprietary technology to work around this difficulty and gain a buffer of 10 ns so the system could stay with 100-ns SRAM and still have no wait states.

When you try to buy SRAM memory, however, you run into the major disadvantage of this approach: cost. SRAM chips generally cost much more than comparably rated DRAM chips. The cost is high enough that none of the current high-end 80386-based systems are using SRAM for their main memory.

Playing the Odds

All three of the above methods yield systems with a guaranteed level of performance. Systems that use them pay a fixed number of wait states—zero or more—essentially all the time.

If you feel like playing the odds, there are other options. As they execute, computer programs follow common patterns most of the time. Programs tend to work in relatively small areas of code and data

BEST BUY IN THE MARKET!

80286 EGA SYS w/ 20 MB HDD

- 80286-10 (10/6 MHz) ■ 640K RAM
- 1.2MB FDD ■ 200W POWER SUPPLY
- 101 KEYBOARD ■ 808287 MATH SOCKET
- W.D. CONTROLLER (2 HDD, 2 FDD)
- TURBO-SPEED BUTTON W/LED INDICATOR
- KEYBOARD LOCK & RESET BUTTON
- PHOENIX BIOS ■ 20 MB HDD (ST-225)
- SERIAL,PARALLEL, GAME PORT
- EGA G CARD (AUTO S/W)
- EGA MONITOR (640 x 350)
- COMPUTER CABINET DIMENSIONS 21"L x 16.5"W x 6"H

$1595.

OPTION: ■ 12MHZ 0 WAIT STATE
OPTION: ■ NEW COMPACT SIZE CABINET (DIMENSION - 14.5"W x 16"L x 7"H)

TURBO-XT MONO SYS w/20MB HDD

- 8088-2 8 MHz TURBO CPU
- 640K RAM ■ 1-360K FLOPPY DISK DRIVE
- 1-20 MB HARD DISK W/CONTROLLER
- CLOCK CALENDAR W/BATTERY BACKUP
- SERIAL,PARALLEL,GAME PORT
- MONO GRAPHIC CARD
- 12" TTL AMBER MONITOR
- FRONT RESET & TURBO SWITCH
- POWER & TURBO LED INDICATOR
- 101 FULL FUNCTION ENHANCED KEYBOARD
- 150W POWER SUPPLY

$895.

80386 COMPUTER SYSTEM w/40MB HDD

- 32 bit 80386-16 MHz CPU ■ 40 MB HARD DISK (ST-251 40ms)
- 1 MEG RAM (80ns) ■ 1.2 MB FLOPPY DISK DRIVE
- 200W POWER W/DESKTOP CASE
- SERIAL, PARALLEL, GAME PORT ■ 101 ENHANCED KEYBOARD
- MONO GRAPHIC CARD ■ 14" TTL AMBER MONITOR

$2785.

1800-545-9777
COD requires cash

SUNTRONICS, INC.
Since 1976

HEAD OFFICE
12603 S. CRENSHAW BLVD
HAWTHORNE CA 90250 M-F 8:30-5:30
(213) 644-1140
ORANGE CO. STORE
108 W. KATELLA AVE M-F 10-6
ORANGE CA 92667 SAT 10-5
(714) 538-0929
CUSTOMER SERVICE (213) 644-1140

1 YEAR WARRANTY PARTS & LABOR ALL ITEMS IN STOCK!
PRICES SUBJECT TO CHANGE WITHOUT NOTICE.
CALL FOR OTHER CONFIGURATIONS!
■ 30 DAY MONEY BACK GURANTEE!
YOUR COMPLETE SATISFACTION IS OUR TOP PRIORITY. ANY SUNTRONIC SYSTEM MAY BE RETURNED WITHIN 30 DAYS FROM THE DATE OF SHIPMENT FOR REFUND LESS SHIPPING CHARGE.
* ITEMS RETURNED MUST BE AS-NEW WITHOUT MODIFICATION OR DAMAGE ALL MANUALS AND PACKAGING MUST BE INCLUDED. RETURN SHIPPING MUST BE PREPAID AND INSURED. BEARING A RMA (RETURN MATERIAL AUTHORIZATION) ON THE SHIPPING LABEL.

Circle 217 on Reader Service Card

for a fairly long time (in processor terms) and then go through a short transition period and move to a new area. This concept is fairly intuitive: Most programs, like most people, act on input relatively soon after they get it, mull it over for a time, and then move on.

Most 80386-based computers use statistical methods that count on the fact that most programs behave this way most of the time. They typically use 80-ns to 120-ns DRAM in conjunction with an architecture designed to capitalize on this type of program behavior.

When the program that is currently executing follows the predicted pattern, 80386s run with no wait states. When that program deviates from the pattern, there is often a penalty of one or two extra wait states beyond those required by the slower DRAM.

Each program's particular mix of instructions and data flow affects its performance. Minicomputers and mainframes have used various kinds of statistical approaches for years.

In addition to their gambling nature, most of these approaches share one other attribute: They concentrate far more on speeding memory reads than on helping memory writes. They do so because most programs read from memory far more frequently than they write to it. Some systems even let memory writes always run with wait states.

Interleaved Memory

Systems that use *interleaved*, or *bank-switched*, memory try to avoid paying the overhead of DRAM recharge time for most memory accesses. They rely on the fact that programs will tend to access memory locations consecutively.

To capitalize on this type of behavior, they divide memory into banks. The banks recharge at different times, so that only memory in the bank that the processor just accessed has to recharge. The other banks are available immediately.

The memory is split among the banks so that each bank contains every *n*th address, where *n* is the number of banks. In the simplest model, which most interleaved PC-based 80386s follow, there are two banks. One bank holds the memory locations with even addresses, and the other holds those with odd addresses. As long as a program accesses memory sequentially, it runs with no wait states. It hits first one bank, and then, while that bank is recharging, the other one.

This approach is great if a program is executing straight-line code (one statement after another with no jumps), because then the processor is fetching consecutive instructions from consecutive memory addresses. When a program starts working with memory locations that are not consecutive, as it might when it jumps or reads data, then it has a 50 percent chance of hitting the bank that is ready to go. If a program needs two memory locations from the same bank, then it is forced to pay the usual wait-state penalty.

The Chips & Technologies 386 support chip set (and, therefore, the machines that use it, such as the Tandy 4000) employs this architecture. That chip set's interleaving only works, however, when there is an even number of memory banks. If there is only one memory bank, it runs with wait states. This is why the Tandy 4000 runs faster with two 1-megabyte banks of memory than it does with one.

continued

Paged Memory

Another statistical option is *paged,* or *static-column,* DRAM. Don't be confused by the name: This approach does not use SRAM. It uses special DRAM chips that are more expensive and harder to find than normal DRAM chips, but they are still DRAM and far less expensive than SRAM.

This approach divides memory into fairly small (typically, 2K-byte) chunks, or *pages.* Consecutive accesses to memory locations in the same page can run without wait states. The word *static* refers to the portion of the address of each of those locations that identifies the page, because that portion does not change between the two memory accesses. When the program has to change that address portion (i.e., when it has to get memory outside the current page), it runs with the normal wait states.

Paged memory works best when programs tend to work repeatedly on the same page of memory. This situation occurs with page-size chunks of straight-line code, as well as with loops that fit within a page.

The first Compaq 80386-based system, the Compaq 386/16, used this approach with 2K-byte pages. Compaq claimed that it yielded an effective performance of about 0.8 wait states with 100-ns static-column DRAM.

Caching

While you can find 80386-based systems that use all these approaches, most of today's speedsters have settled on a compromise between SRAM and DRAM that involves a memory *cache.*

A cache is a small portion of very-high-speed memory. Most of today's fastest 80386 systems use a 32K-byte or 64K-byte cache of 25-ns to 35-ns SRAM. They use 80-ns to 120-ns DRAM for the bulk of their memory. The goal of the cache is to give as much of the performance benefit of SRAM as possible with a minimum amount of the expense.

The principle behind caching is easy to see: If the memory location the processor needs is in the cache (a cache "hit"), then it can get that memory without any wait states. With a 25-ns SRAM cache, a system can easily support even a 25-MHz 80386. If the memory the processor needs is not in the cache (a "miss"), then the processor has to pay in wait states while the memory comes from the slower DRAM (see the figure on page 102).

Any memory that the processor needs from DRAM goes into the cache, so if the processor needs it again later, it might be there. Of course, because the cache is small, it is usually full, so new entries have to displace old ones. When that happens, most caches use a technique known as LRU (least recently used) replacement to determine which entry to remove. This technique picks for removal the cache entry that the processor has least recently used.

Caching, like the other statistical approaches, counts on programs working with a relatively small number of memory locations for relatively long stretches of time.

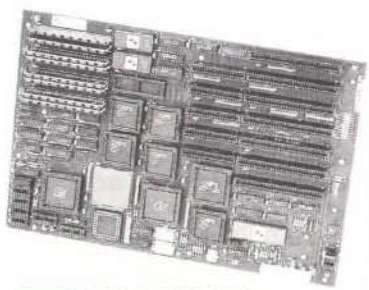
You can state the effectiveness of a cache by its *hit rate,* which is the percentage of the time that the memory the processor needs is in the cache. One of the most common cache controllers, the single-chip Intel 82385, claims a hit rate of 95 percent with a 32K-byte cache. Many of today's fastest 80386-based com-

continued

WE KEEP YOU ONE STEP AHEAD OF THE COMPETITION

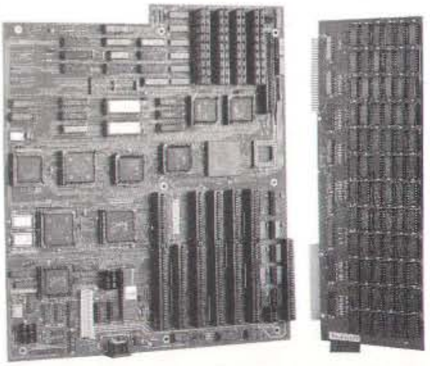
They are high quality – we understand that your reputation relies on ours
They are backed with great service: local repair, same day or next day delivery on just about any quantity, one year warranty

DIGIS-NEAT 16 MHz/20 MHz
- XT size 286 based, 4 layer MB, C & T NEAT chip set
- 8/16/20MHz, 0/1 wait-state, soft selectable
- Either SIM Module or 256K, 1MB DRM can be used
- Expandable to 8MB. LIM, EMS Memory Controller
- MS-DOS 3.XX, UNIX, XENIX and OS/2



DIGIS-386S 16/20/25 MHz
- Intel 80387-20 CPU with zero wait state operation
- High-Tech 6 layers, XT size
- Memory capacity:
  - 2MB on board using 32 bit 256K RAM module
  - 8MB on board using 32 bit 1MB RAM module
  - 80287 and 80387 sockets "built-in" available

DIGIS386M 16/20/25 MHz
- Intel 80386 CPU, 0 wait state operation
- Memory capacity:
  Max 16MB, 8MB on board, and 8MB on RAM card
- Optional socket for 80287 and 80387 Math Co-processor
- 2 serial ports and 1 parallel port on board
- Fully compatible Bios
- Can run MS-DOS, PC-MOS, OS/2, UNIX and more



American Digicom Corporation
Call **408-245-1580**
Fax: **408-245-1584**
424 Oakmead Parkway
Sunnyvale, CA 94086

Dealer, OEM, VAR
Pricing Available

Hitech Materials
Call: **805-964-3535**
Fax: **805-683-8525**
5775 Dawson Ave. Goleta
Santa Barbara, CA 93117

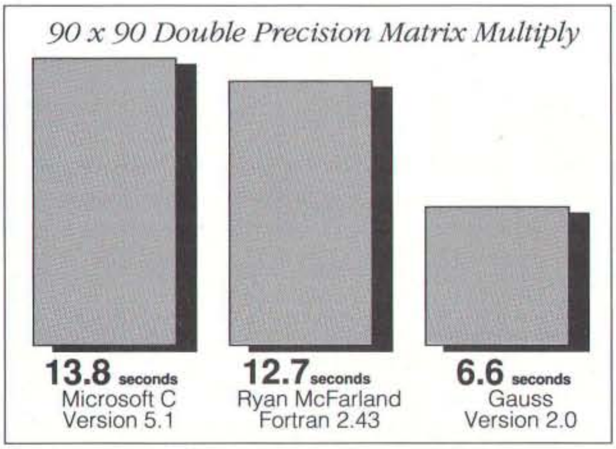
Circle 9 on Reader Service Card

GAUSS

Instant Wait Reduction

Now you can run most routines at or near the capacity of your hardware.

From Bell Labs to Caltech, research scientists and engineers have found GAUSS can help them solve problems with their PCs that would take them hours longer with conventional languages. And not only does GAUSS run fast, it's easier to program because its language is closer to mathematical syntax. GAUSS allows you to easily enter your own ideas even if you are not a programmer and saves time by including over 200 mathematical routines. You can even call your favorite Fortran, C or assembler subroutines.



Now GAUSS 2.0, the second generation of the new breed of matrix handling programming languages is available, with indexed, easier-to-use documentation, on-line debugger and Smart™ on-line help that can even handle your own functions. And GAUSS 2.0 is faster, up to 20% on some calculations, compared to our previous versions.

The GAUSS system includes publication quality graphics and a library of mathematical routines and applications, documented in the updated 2.0 manual. All this for the total price of just $395. So don't waste another minute running at half speed, order GAUSS 2.0 today.

We're so sure GAUSS will make you more productive, giving you more answers to more questions more quickly, that we guarantee it.

If you are not completely satisfied with the power, speed and flexibility of GAUSS simply return it for a full refund. No questions asked. Call **(206) 631-6679** to order.

GAUSS - faster, easier, smarter...guaranteed.

SATISFACTION • GUARANTEE • CUSTOMER • 100%

GAUSS™ 2.0

FOR IBM PC-XT-AT-PS/2 & COMPATIBLES
WITH MATH COPROCESSOR

BY APTECH SYSTEMS, INC.
26250 - 196th Place SE
Kent Washington 98042
Phone (206) 631-6679
FAX (206) 630-1220
CALL OR WRITE FOR FREE BROCHURE

IBM IS A REGISTERED TRADEMARK OF INTERNATIONAL BUSINESS MACHINES
ALL TESTS RUN ON AN IBM PS/2 MODEL 80 16 MHz.

puters, including the most recent machines from Compaq, ALR, and IBM, use the 82385.

Many cache controllers, however, do not handle memory writes as well as memory reads. Some caches send all memory writes to main memory, even if the desired memory location is in the cache. This technique is called *write-through*. It forces all main memory to pay the wait-state penalty of the slower system DRAM.

More sophisticated cache controllers, such as the 82385, use a *posted-write* approach to handle memory writes. If the memory location that is the object of the write is in the cache, the cache controller writes to the cache immediately, with no wait states. Then, while the processor is busy working on other things, the cache controller sends the memory write out to the main memory.

There are two potential problems with the posted-write technique. During the time after the cache controller writes to the cache and before it has finished writing to the slower DRAM, the values for the changed location are different in the cache and in the main DRAM. The DRAM location is out of date. If only the 80386 can read memory, that's no problem, because the 80386 can get the correct value from the cache. Most microcomputers, however, contain other direct-memory-access components, such as peripheral controllers. Those components can go to memory directly and could encounter out-of-date DRAM locations. The cache controller must make sure that any DMA reads get the correct value for each memory location.

Unfortunately, the problem can go the other way as well. A DMA component can write to a location in main memory that the cache controller is also keeping in the cache. The cache is then out of date, and if the processor reads that location from the cache, it will get an out-of-date value.

The 82385 solves this problem by a technique known as *bus snooping*, in which it monitors the system's bus constantly and watches for DMA writes. When a DMA device writes to memory, the 82385 checks the address of each target location to see if that location is in the cache. If it is, the 82385 marks the cache copy as invalid, so that the next time the processor tries to read that address, the cache controller will fetch the correct value from main memory.

The Winner?

Caching works most of the time for most applications; however, like the other statistical approaches, it offers no guarantees. The only architecture that can guarantee no-wait-state performance is pure SRAM, and most system manufacturers today consider it prohibitively expensive.

Because of the availability of relatively inexpensive, single-chip cache controllers like the Intel 82385, most of today's fastest 80386-based systems use caches. Some manufacturers, such as ALR with its FlexCache 25386, are also building their own cache managers.

In either case, caching seems to be the architecture of choice for the fastest 80386-based computers today, and it is most likely to remain so for some time to come. ■

Mark L. Van Name is a freelance writer and computer consultant. He can be reached on BIX c/o "editors."

FIVE GOOD REASONS TO BUY A MOUSE-TRAK.™

Count them. With MOUSE-TRAK, five fingers do all the work. Because it uses trackball technology, input and precision control is at your fingertips, not your elbow.

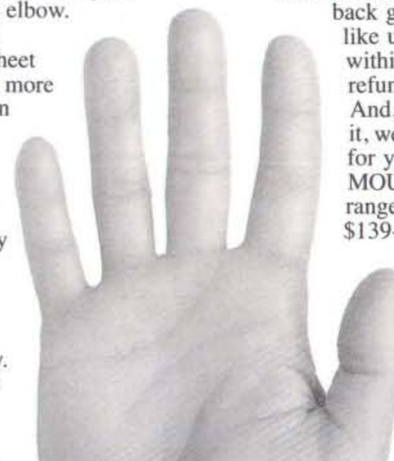
With CAD, Desktop Publishing or Spreadsheet applications, MOUSE-TRAK is easier, faster, more relaxed and a lot more comfortable to use than ordinary input devices.

MOUSE-TRAK OFFERS YOU OPTIONS
2 or 3 buttons — speed control — Multiple Interfacing

MOUSE-TRAK is stationary. Only the highly efficient trackball moves, eliminating tiresome arm and wrist movement. You can operate MOUSE-TRAK in your hand, even sit back with it on your knee. It plugs into your computer and needs no additional power supply.

User definable input keys are in easier-to-use locations. The uniquely patented shape has been developed through rigorous ergonomic studies of hand sizes and finger geometry. Made in the U.S., MOUSE-TRAK is already in use by the military in planes, subs and tanks. Engineers at IBM™, Texas Instruments™ and Motorola™ are also using MOUSE-TRAKS.

MOUSE-TRAK carries a money back guarantee. If you don't like using MOUSE-TRAK within 30 days, we'll refund your money. And, if you do like it, we'll give you $10 for your old mouse. MOUSE-TRAK ranges in price from $139-$189.



MOUSE-TRAK combines mouse interface technology with the convenience and precision of a tracking ball. There's no wasted motion or time.

Call us toll-free for the complete story on MOUSE-TRAK and the name of a dealer near you. Our new brochure is available upon request.

1-800-533-4822
(in Texas 214-494-3073)

mouse-trak®

3121 Benton Street, Garland, Texas 75042 USA, Telefax 214-494-4159

IBM, Texas Instruments and Motorola are registered trademarks of their respective companies. MOUSE-TRAK is a registered trademark of ITAC Systems, Inc.

Circle 115 on Reader Service Card

AST Premium FASTboard/386™ Is One More Reason

Why This Is Still The Hottest 286 PC In The Business.

"Best looking. Best built. Best performing." That's the way industry experts describe the AST Premium®/286. We'd like to add something new: "Best solution for 386 upgradeability." Thanks to the AST Premium FASTboard/386.™

It instantly gives the AST Premium/286 high-performance 16 MHz, 386™ processing power with true 32-bit memory and high-speed 64Kb cache. Which is like getting a whole new computer that supports the next generation of multitasking, multiuser software without paying a whole new price.

The AST Premium/286's FASTslot™ architecture makes the upgrade to 386 power simple and easy. Forget about removing or disabling the 286 chip. Or fussing with cable connections to the 80286 socket. Plus, you retain the 80286 processor, which allows you to continue running 286-based software.

And unlike other 386 upgrade solutions, AST Premium FASTboard/386 provides plenty of 32-bit system memory. Up to 8 MB to take full advantage of 386 operating system software, such as Microsoft® Windows/386,™ XENIX™ and UNIX.™

So, for the hottest 286 on the market today that provides high-performance 386 processing power in the future, think FAST. Fast and easy AST Premium/286 upgradeability with AST Premium FASTboard/386. For more information, call **(714) 863-0181** and ask for **operator AA50**. Or fill out the coupon below.

☐Please send me more information on the
AST Premium/286 and the
AST Premium FASTboard/386.

☐Please have an AST representative call me.

Name ____________________

Title ____________________

Company ____________________

Address ____________________

City __________ State ____ Zip ______

Phone (______) ____________________

Send to: AST Research, Inc. 2121 Alton Avenue, Irvine, CA
92714-4992, Attn: M.C.

BYTE 10/5/88

AST® RESEARCH INC.

AST is proud to sponsor NBC's telecast of the 1988 Summer Olympics

Times Have Changed.

AST markets products worldwide—in Europe and the Middle East call: 44 1 568 4350; in the Far East call: 852 5 717223; in Canada call 416 826 7514. AST, AST logo and AST Premium registered and AST Premium FASTboard/386 and FASTslot trademarks AST Research, Inc. All other brand and product names are trademarks and registered trademarks of their respective companies. Copyright © 1988 AST Research, Inc. All rights reserved.

INTERACTIVE's 386/ix runs UNIX...

SVID-certified UNIX for the 386. Software Development Tools. Text Processing. VP/ix™ MS-DOS* under UNIX . Network Connection Facilities: RFS, NFS, TCP/IP. TEN/PLUS* Users Environment. X Windows.*

INTERACTIVE developed UNIX V.3 for the 386 with AT&T and Intel. And, as you might expect, thousands of UNIX applications run on 386/ix unmodified. That's what standards are all about.

and MS-DOS...

INTERACTIVE developed VP/ix with Phoenix Technologies in order to run MS-DOS programs under UNIX. Here are a few of the thousands of DOS programs that run unmodified under our VP/ix.

and XENIX.

INTERACTIVE incorporated XENIX compatibility into UNIX. Here are a few of the hundreds of XENIX-based applications that run unmodified on the 386/ix Operating System.

Come See Us At ***UNIX EXPO*** *Booth No. 721*

INTERACTIVE
SYSTEMS CORPORATION A KODAK COMPANY
2401 Colorado Avenue Santa Monica, California 90404

Call free of charge: ***1-800-346-7111***

386/ix is a trademark of INTERACTIVE Systems Corporation; TEN/PLUS is a registered trademark of INTERACTIVE Systems Corporation; VP/ix is a trademark of INTERACTIVE Systems Corporation and Phoenix Technologies Ltd.; UNIX is a registered trademark of AT&T; XENIX and MS-DOS are registered trademarks of Microsoft Corporation. Copyright 1988, INTERACTIVE Systems Corporation.

Circle 113 on Reader Service Card (DEALERS: 114)

WHITHER IBM AND UNIX?

New entries in the operating system arena have heated up the battle for a powerful, standardized microcomputer version of Unix

Jason Levitt

Although Microsoft and IBM would have us believe that OS/2 is the operating system of the future, Unix has been gaining ground in the operating system marketplace. And while IBM has maintained a low profile in the Unix world, it is nevertheless a force to be reckoned with.

IBM has had Xenix and PC/IX running on the AT for some years now. Microsoft's Xenix, the most ubiquitous Unix in the industry, is well known. PC/IX, Interactive Systems Corp.'s (ISC) port of Unix System III to the XT and AT, is more obscure. PC/IX is an AT&T-licensed port of Unix that performs well on a PC XT and has proved itself in several documented projects, the most profound being Andrew Tannenbaum's Minix, a Unix version 7-compatible operating system developed under PC/IX. Unfortunately, PC/IX fell prey to anemic marketing and support due to its potential competition with IBM's proprietary products.

At the end of last year, Xenix became available for the IBM PS/2 in the form of SCO Xenix 386 from the Santa Cruz Operation (December 1987 BYTE). Now IBM is trying to center its entire Unix strategy for large and small systems around a version called AIX.

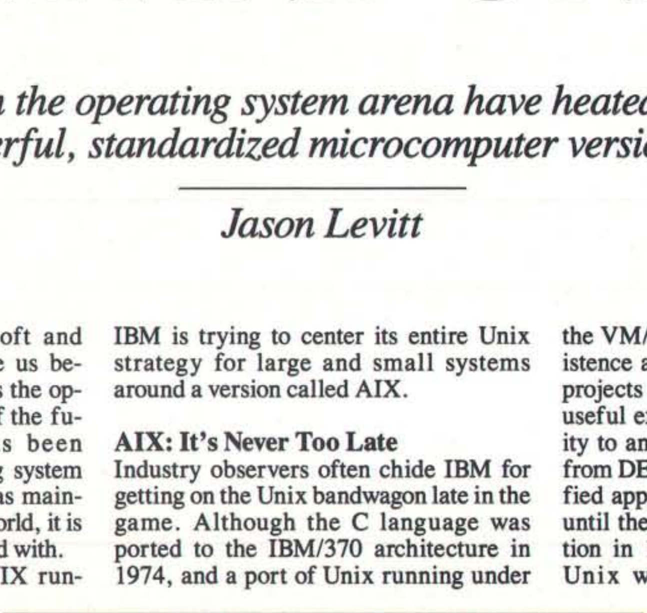


ILLUSTRATION: MARY ANN SMITH © 1988

AIX: It's Never Too Late

Industry observers often chide IBM for getting on the Unix bandwagon late in the game. Although the C language was ported to the IBM/370 architecture in 1974, and a port of Unix running under the VM/370 operating system was in existence as early as 1976, these were not projects sponsored by IBM, but simply useful exercises demonstrating portability to an architecture radically different from DEC's PDP-11. IBM's current unified approach to Unix didn't take shape until the introduction of its RT workstation in 1985, nearly two years behind Unix workstation leaders Sun and Apollo.

AIX is ISC's port of Unix System V version 1.0 to the RT's RISC (reduced instruction set computer) processor. With the recent release of AIX for the PS/2 Model 80, AIX is now IBM's unified Unix approach for the future. Today, after several years of furious development within IBM, outside the auspices of ISC, AIX has matured considerably. The technical improvements of System V version 2.0, along with bits of version 3.0, and a host of Berkeley (BSD 4.2) Unix enhancements have been incorporated into AIX. AIX has its own distributed file system (see "The IBM RT Gets Connected," in the Fall 1987 *Inside the IBM PCs*).

One of the unique features of AIX is its use of the Virtual

continued

Resource Manager (VRM), an interface that hides the complexities of the hardware from the operating system software (see figure 1). In its original incarnation, the VRM could be viewed as a tiny version of VM/370, hosting different operating systems as specialized virtual machines. The AT coprocessor card, running DOS, is viewed by the VRM as a virtual machine. The VRM provides additional features not present in System V, such as virtual terminals (full-screen windows) and real-time capabilities.

An entity such as VRM, however, is not popular in the Unix world because of its proprietary hooks. Here is an interface written in IBM's own proprietary PL.8 systems language that hosts different operating systems and requires a VRM device driver for any corresponding specialized Unix device driver. Fortunately, the need for such a robust foreign interface within IBM's unified Unix strategy is waning. Andy Heller, IBM vice president and general manager of Advanced Engineering Systems, says, "We gave the VRM more autonomy than it really did need. Over the next year or two, the VRM as a stand-alone entity will probably disappear. But all of the interfaces that are part of the VRM, all of the Virtual Machine Interface structures will be there because those really are needed to use the system in a broad spectrum of applications."

Clearly, IBM sees OS/2 as being for end users and AIX for technical and research environments: "different operating systems coming from different heritages with different applications."

AIX and SAA: Big Pieces of the Puzzle

At a recent Uniforum conference, William Lowe, president of IBM's Entry Systems Division, said that AIX would eventually conform almost entirely to IBM's Systems Application Architecture, except for the user interface. The SAA specifies a set of interconnectability and software consistency across the broad range of IBM's hardware. Interestingly, the SAA's user interface is OS/2's Presentation Manager. So, although AIX for the PS/2 Models 70 and 80 is scheduled for release in the fourth quarter of this year, right alongside OS/2's Presentation Manager and beefed-up networking, it will still be essentially a line-oriented version of Unix (see the text box "OS/2 versus Unix" on page 112).

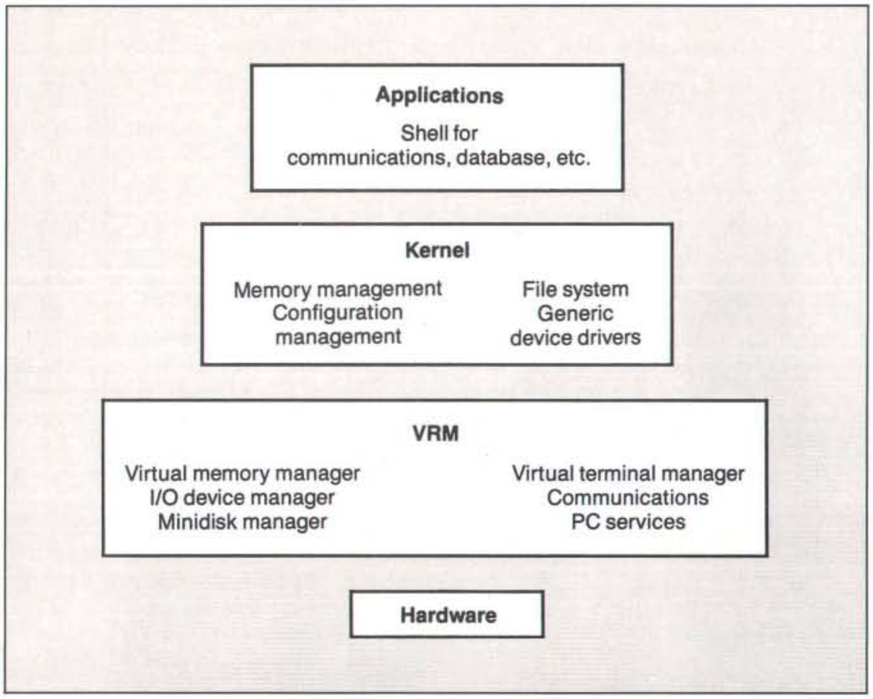


Figure 1: *AIX's Virtual Resource Manager (VRM) hides the complexities of the hardware from the operating system software.*

Although AIX includes MIT's windowing interface, X-Windows (but without applications written using the X libraries), it is only a little better than the full-screen windows available under AIX and Xenix, which allow the user to flip through virtual terminal sessions using a hot-key sequence. Clearly, IBM sees OS/2 as its solution for end users and AIX as the solution for the technical and research environments. Heller describes the IBM view as "different operating systems coming from different heritages with different applications."

So, although AT&T and Sun view Unix as the end-user solution, IBM plans to delegate only those tasks to Unix that it doesn't perceive to fall into the realm of OS/2 applications.

Unix and OS/2: Big Differences

If you're a Unix user, you need only pick up a copy of OS/2 Standard Edition 1.0 at your local computer store to see the disparity in these two operating systems. As packaged, OS/2 appears very much like MS-DOS. The same hierarchical file system persists, and, save for the addition of a handful of commands, the command-line prompt is the same barren landscape. A user-friendly shell called the Program Selector lets you jump among applications running in full-screen windows. OS/2 is multitasking, not multiuser, and it has a full complement of operating system facilities available to the systems programmer, including most of the interprocess communication facilities present in System V.

If you paid $3000 for the Microsoft OS/2 Software Developer's Kit, you can begin to hack out OS/2 programs using Microsoft C, CodeView, and a handful of utilities. To be fair, nobody really expects OS/2 to have the depth of software tools that is available under Unix. It's just a shame that so many common functions have to be programmed from scratch or purchased in order to create a useful software development environment. One major thing OS/2 and Unix do have in common is that they are both written largely in C.

And What About Xenix?

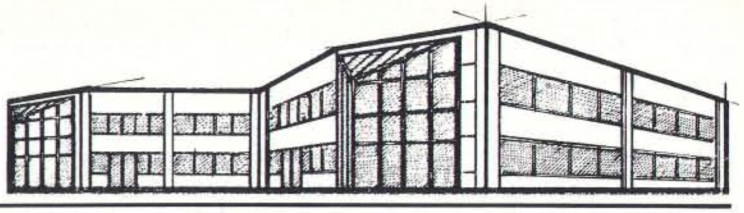
The availability of Xenix on PS/2 Models 70 and 80 is of little interest to IBM,

continued

ORDER TOLL **FREE**
1-800-421-3135

Servicing our PC Buyers with
low pricing and technical experience since 1979.

WAREHOUSE DATA
PRODUCTS



AT WAREHOUSE DATA PRODUCTS

You'll find both everyday discounted prices on Brand Name Equipment, and courteous and knowledgeable salespeople to help you as well.

- We're not just a telemarketer.
- We're a Computer Center.
- We work closely with our International Customers and make an extra effort to accommodate their needs.
- Sales, Rental and Leasing.
- Hardware & Software – Over 15,000 items in stock.
- Technical Support – Including equipment repair.

FREE SOFTWARE!

Purchase over $100 and receive one of these disks absolutely FREE! Purchases over $250 get two free disks, over $400 get three, or get all four disks when your purchase is over $500! **1) MIXED BAG. 2) PC-WRITE. 3) FONT-SET. 4) ABC-LIST.**

MICROSOFT PC Excel SPECIAL $273

–SOFTWARE–

Accounting

Dac Easy Acct. 3.0	Low Price
Dac Easy Light	$39
Dac Easy Payroll	Low Price
Dollars & $ense	94
In House Acct.	112
Managing Your Money 4.0	117

Communication Programs

Brooklyn Bridge Universal	$75
Carbon Copy Plus	108
Crosstalk XVI	89
Crosstalk MK4	110
Flying Dutchman	64
PC Anywhere III	96

Data Base Managers

Clipper	$370
Condor 3	325
DataPerfect	Low Price
DBase III Plus	375
DB-XL Diamond	115
Fox Base Plus	194
Genifer	189
Paradox 2.0 Premium	435
PFS: Pro File	139
Powerbase	169
Q&A 3.0	Call
Quicksilver Diamond	329
Revelation Advanced	485
R Base For DOS	425
Reflex	90
Relate & Report	112
VP Info	65

Desktop Publishing

Pagemaker Ver. 3.0	$475
PFS: First Publisher 2.0	73
Ventura Publisher	489

Graphics

Boeing Graphics	$200
Chartmaster	199
Design Cad 2D & 3D	148
Diagram Master	199
Easy Cad	109
Generic Cad	49
In-A-Vision	270
Microsoft Chart 3.0	225
Newsroom Pro	65
Printshop	33

Integrated

Ability Plus	$145
Enable	352
Microsoft Works	108
PFS 1st Choice	79
Smart System	380
Symphony	465

Languages

Lattice C Compiler	$220
Microsoft C Compiler Ver. 5.0	Call
Microsoft Fortran Ver. 4.1	260
Microsoft Macro Assembler Ver. 5.1	88

Languages

Microsoft Pascal	$176
Microsoft Quick Basic 4.0	59
Microsoft Quick C	Call
Ryan McFarlan Fortran	390
Ryan McFarlan Cobol	612
Turbo Basic	Call
Turbo C 1.5	59
Turbo Pascal	Call
Turbo Prolog	90

Multi-User Software

Fox Base +	$299
Microsoft Word	195
Word Perfect 5.0	339
Word Perfect Modules	ea 75

Project Manager

Microsoft Project	$305
Super Project Plus	255
Timeline 3.0	323
Total Havard Man. 2	355

Spreadsheet

Lotus 1-2-3	$280
Microsoft PC Excel	273
Quattro	143
Surpass	329
Twin	35
VP Planner Plus	88

Utilities

Core Fast	Low Prices
Copy II PC	$19
Copywrite	39
Cubit	39
Desqview 2.01	72
Direct Access	49
Eureka	Call
Fastback Plus	89
Formtools	56
Graph in the Box 2	Call
Mace	55
Microsoft Windows 286 Ver. 2.1	59
Norton Advanced	75
Norton Utilities	48
PC Tools Deluxe	37
Prokey 4.0	70
Q DOS II	49
Righwriter	75
Sidekick Plus	115
Sideways	39
SQZ Plus	55
Superkey	55
Lightening	79
XTree	35

Word Processing

Microsoft Word 4.0	$185
Multimate Advantage II	285
Q and A Write	110
Webster Spellcheck	37
Word Perfect Ver. 5.0	Call
Word Perfect Executive	124
Word Perfect Library 2.0	65
Wordstar Pro	233
Wordstar 2000 + Personal Ed.	229

–HARDWARE–

Accessories

Copy II PC Deluxe Bd.	$101
Curtis Ruby +	69
Logical Connection	429
Mach III Joystick	36
Masterpiece	85
Masterpiece +	95
150 Watt Power Supply	69

Boards

AST	
Rampage/2	Call
Rampage 286 w/512K	$299
Sixpac Plus w/64K	129
All Other AST Products	***Call***
EVEREX	
2MB Above PC/XT w/o Mem	79
3MB Above AT w/o Mem	89
ORCHID	
Ram Quest Extra PS/2	Call
INTEL	
Above PC 64K	225
Above 286 w/512K	344
Orchid Tiny Turbo	289

COMPUTERS

EVEREX	
286, 10MHz, 0 Wait	$1149
286, 10MHz, 1 Wait	999
286, 12.5MHz, 0 Wait	1349
ACER	
710 w/o Monitor	Call
900 w/o Monitor	Call
SHARP	
PC 4501	$765
PC 4502	Call
PC 4521	Call
AT&T	
6286 WGS	1499
6300 WGS	919
6386 WGS, 40 MB H.D.	2999
6386E, 135 MB H.D.	4599
ZENITH	
Super Sport 286/20MG	Call
Super Sport 8088/2-Floppies	Call
Super Sport 8088/20MG	Call
NEC	
Multispeed-2	Call
All Other NEC Products	***Call***

EGA Boards

AST VGA + (16 Bit)	$320
All Other AST Products	*Call*
ATI Ega Wonders	175
Genoa Super EGA Hi-Res +	186
Orchid Designer	259
Paradise Auto 480	179
Paradise VGA Plus	269
Paradise VGA Proff.	399
Vega VGA	275

EGA Monitors

Casper	$410
Princeton Ultra Scan	539
Mitsubishi Diamond Scan	509
NEC – Multisync II	599
Zenith 14" Flat Screen	650

Hard Cards

Plus 20 MB	$529
Plus 40 MB	659

Hard Drives

Seagate ST-225 20 MB w/cont	$265
Seagate ST-238 30 MB w/cont	295
Seagate 40 MB AT 251-2	399
Seagate 80 MB AT	579
Seagate ST-125 w/cont	329
Seagate ST-138 w/cont	399
Priam	Call

Monitors

AMDEK	
410 Amber	$145
MAGNAVOX	
RGB	255
SIGMA	
Laserview + 19"	Call
SAMSUNG	
Flat Amber	Call
TTL Amber w/tilt	76
Color w/tilt	249
Viking	Call

Printers

CITIZEN	
MSP 40	$285
120 D	146
MSP 50	385
EPSON	
LQ 500	349
LQ 850	559
FX-850	Call
LASERS	
Other Lasers	Call
AST TURBO PS	Call
OKIDATA LASERLINE 6	1379
OKIDATA	
OKI 320	Call
OKI 321	Call
OKI 390	489
OKI 391	679
STAR MICRONICS	
NX 1000	179
NX 1000 Color	238

Modems

AZ 2400 INT w/o Soft	$129
Everex 300/1200 w/ Soft	69
Everex 2400 EXT, Error Cor.	189
Hayes 1200 EXT w/o soft	299
Hayes 1200B INT w/ Soft	289
Hayes 2400 EXT w/o Soft	435
Novation Parrot 1200 w/Soft	99
U.S. Robotics 2400 w/o Soft	335

Mice

Genius	$49
Logitech	68
Microsoft Bus w/Paintbrush	92
Microsoft Serial	92
Optimouse w/Dr Halo	89
Optimouse w/DPE	185

TERMS: Shipping mininmum is $5.00. AZ orders + 6.7% sales tax. Personal check/company check – allow fourteen (14) days to clear. We accept purchase orders from authorized institutions for 3.5% more than cash price. All returns are subject to our approval. There will be a 20% restock fee. Minimum phone order $50. All prices are subject to change. Due to copyright laws we cannot take back any open software.

We do not guarantee compatibility
No Charge for MasterCard or Visa

Order Status,
Technical & Other
Info. (602) 246-2222
FAX #(602) 246-7805

Call for programs not listed

Having Technical Problems? – Call Us!

Phone Hours: Monday thru Friday 6:30 a.m.-9:00 p.m. MST
Saturday 9:00 a.m.-5:00 p.m. MST

TOLL-FREE ORDER LINE 1-800-421-3135
WAREHOUSE DATA PRODUCTS
2727 West Glendale Ave.
Phoenix, AZ 85051

Circle 229 on Reader Service Card

OS/2 versus Unix: Is DOS Compatibility the Key?

The three main strengths of OS/2 are ease of use, DOS compatibility, and IBM connectivity. The architects of OS/2 make no secret of the fact that DOS compatibility took a huge amount of effort in the development of OS/2. Trying to develop a new operating system designed to overcome the limitations of DOS but at the same time maintain compatibility with it has clearly been one of the stumbling blocks for the developers. OS/2's IBM connectivity is strictly in the form of the LAN Manager and the Database Manager, both of which adhere closely to standards in the IBM mainframe environment, like the 3270 and DB2, but ignore standards of the DOS and workstation environment, like dBASE and Ethernet.

While OS/2 has other drawbacks, some of these may not be that important in the long run. OS/2 runs only on 80286- and 80386-based systems and adheres to the limitations of the 80286 chip (only 16 megabytes of addressable physical memory, for example). However, an 80386 version of OS/2 will supposedly be available late next year.

OS/2 is not a multiuser system, but advances in networking and distributed software will eventually make this a moot point. And although there are currently few applications available under OS/2, we can make the assumption that piles of software are being prepared to take advantage of OS/2's capabilities. OS/2 will probably overtake Unix in the breadth and variety of applications available.

While ease of use may be OS/2's most compelling advantage over Unix, the importance of DOS compatibility should not be underestimated. OS/2 offers DOS compatibility through the DOS Compatibility Box (DCB), which allows one DOS program to run at a time under OS/2.

When a DOS program is running under the DCB, it takes control of the screen and keyboard and is subject to all the constraints of MS-DOS: the 640K-byte memory limit, the 32-megabyte hard disk limit, and so on. A hot-key sequence lets you suspend execution of the DOS program and move into a protected-mode OS/2 environment.

Additionally, the DCB operates as one process under the OS/2's scheduler, so the program running in the DCB doesn't get 100 percent of the CPU as it would under DOS. The most extreme example is when you hit a hot-key sequence to temporarily get back to the OS/2 environment: The suspended DOS program gets no processor cycles, so real-time programs or timing-dependent programs will not operate properly. Basically, any DOS program that tries to poll or directly use any hardware without using the appropriate programming interface may fail. And since the offending program is running the 80286/80386's real or unprotected mode, it can bring OS/2 down with it.

In the Unix marketplace, several software packages have emerged in the form of Unix retrofits that allow Unix to execute in the full protected mode of the 80286/80386 while allowing multiple DOS tasks to execute in real mode. A typical system is Merge 286 by Locus Computing. Merge is a seamless union of DOS and Unix. DOS programs can run from either the DOS Environment (DE) provided by Merge or from the Unix shell. You can access both DOS and Unix partitions of the hard disk from either the Unix shell or the DE. Output from DOS commands can even be piped into the standard input of Unix commands.

On the 80286, Merge's limitations are identical to OS/2's: Only one DOS process can execute at a time, and if it decides to write zeros all over memory, it can. On the 80386, though, Merge uses the virtual 8086 mode, allowing multiple DOS programs to execute. (For more on this subject, see "DOS Meets Unix" by Dale Dougherty and Tim O'Reilly on page 117.)

The compatibility issues of DOS/Unix environments are similar to the ones mentioned for OS/2: hardware- or timing-dependent programs cannot run. However, errant DOS processes running under the virtual 8086 mode cannot escape the limitations of their address space and crash the host Unix system. There is no reason to assume, however, that OS/2 will not allow multiple DOS sessions when the 80386 version is released in late 1989.

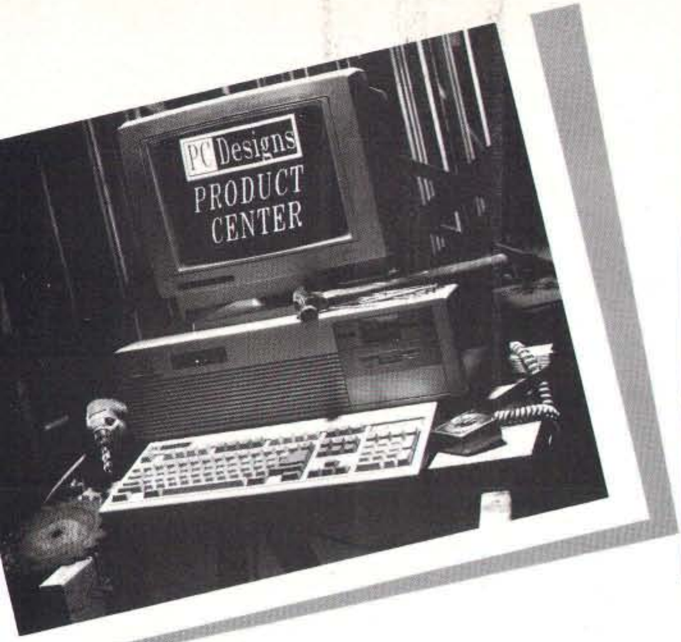
Ease of Use

OS/2 isn't going to win any converts strictly on the basis of DOS compatibility, but it might win some because it is easier to maintain and operate than Unix. This is the issue that springs up every time Unix is mentioned as an end-user system: Unix command syntax is too terse, Unix doesn't provide enough feedback, Unix isn't consistent.

True, Unix is available across a wide variety of architectures and exists in several different flavors. For example, system administration procedures vary significantly on a Sun-3, an IBM RT, and an IBM PS/2 Model 80 running Xenix. And only the Sun-3 has a well-developed windowing system with a lot of applications. OS/2 will have the Presentation Manager for its user interface, and that has the requisite Macintosh look and feel toward which the industry is leaning. Unix will have Open Look providing the same function. Both will be available in the fourth quarter of 1988: Presentation Manager from IBM on the PS/2 Model 80, and Open Look on the AT&T 6386 workstation.

Still, the large percentage of users who were attracted by the raw simplicity of DOS—those who want to run their applications and nothing else—will find, for now, that OS/2 maintains that basic simplicity. The installation and maintenance of OS/2 has been rendered elegantly simple due to the extensive help menus and auto-configuration. Because it's a single-user system, system administration is greatly simplified.

Unix has about a 10-year lead in technology and tools for multitasking, multisystem software development. But considering the massive capital mounting behind the DOS-to-OS/2 push, this might not be such an important point. Unix is still struggling to become a unified standard, and the prospect of waiting until the end of 1989 to see what happens between the AT&T/Sun team and the Open Software Foundation is not a pleasing forecast for Unix enthusiasts.



POWER TOOLS. POWER MINDS. POWER PRODUCTS.

When you combine powerful tools with powerful thinking, you get powerful products. ● PC Designs puts this combination together for you. They've designed and manufactured microcomputers in Oklahoma for over three years. Innovation, high performance, reliability — they're powerful tools in the hands of PC Designs. ● Take the GV-286 and GV-386, for example — two of the fastest, and fairest priced, microcomputers around. The 286 was "Editor's Choice" in *PC Magazine* last year — one of PC Designs' many successes. ● Whatever choice you make, PC Designs offers you unparalleled service and support. Through Sorbus,℠ you have the option of a maintenance contract for nationwide on-site or carry-in service. ● But service is more than a contract. In Oklahoma, it's a Product Center with customer-centered attention. Nationally, it's putting your needs first — offering informed advice, solving complex problems, providing excellent warranties. ● So whatever you're building — build it with the powerful tools of PC Designs.

Sorbus
A Bell Atlantic™ Company

HOURS	8:00-6:00 CST, Monday-Friday 9:00-3:00 CST, Saturday
CALL US AT	1-918-251-5550 (in Oklahoma) 1-918-251-7057 (Fax)
BBS ON-LINE 24 HOURS	1-918-252-9137

All prices are subject to change without notice.

Putting the Power in Your Hands

MICRO 286 - $985.

- 80286, 10MHz
- 512KB, zero wait-state
- 1 serial, 1 parallel port
- 1.2MB or 720KB floppy drive
- 101-key keyboard

GV 286* - $1299.

- 80286, 12MHz
- 512KB, zero wait-state
- 32KB RAM cache
- 2 serial, 1 parallel port
- 1.2MB or 720KB floppy drive
- 101-key keyboard

* *PC Magazine's* 'Editor's Choice' on October 13, 1987

GV 386/16 - $2199.

- 80386, 16MHz
- 1MB, zero wait-state
- 64KB RAM cache
- 2 serial, 1 parallel port
- 1.2MB or 720KB floppy drive
- 101-key keyboard

GV 386/20 - $2599.

- 80386, 20MHz
- 1MB, zero wait-state
- 64KB RAM cache
- 2 serial, 1 parallel port
- 1.2MB or 720KB floppy drive
- 101-key keyboard

Just a Few of Our Many Options:

VIDEO

• Mono card and monitor	$ 175.
• EGA card and monitor	549.
• VGA card and NEC MultiSync II	899.

HARD DISKS

• Priam ID45H (45MB, 28MS)	489.
• Priam ID62 (70MB, 28MS)	659.
• Priam ID130 (160MB, 28MS)	1539.
• Maxtor AT140 (140MB, ESDI, 11MS)	1699.

PC Designs

2500 N. Hemlock Circle • Broken Arrow, OK 74012

CALL US AT 1-800-322-4872 (outside Oklahoma)

Circle 169 on Reader Service Card

Command-Line Unix, Windows, and Open Look

Historically, Unix has had a command-line interface. That is, the interface presented to the user is a simple prompt, like the one in MS-DOS. Unix researchers, though, have been particularly adept at enhancing this command-line interpreter, or "shell," as it's called in Unix parlance, to make it more robust. The result has been the creation of several enhanced shells that provide sophisticated command histories, the ability to retrieve previous typed commands, and a powerful interpreted programming language. The most notable in recent years, and certainly the most imitated, has been the Korn Shell written by David Korn, an AT&T Bell Labs researcher.

As Unix enters the commercial arena, the public has been clamoring for a user interface that is more suitable for end users. The result has been the creation of several windowing systems, but no clear, consistent standard has emerged against all others.

The most mature system is the BSD 4.2–based SunOS, which Sun has sold with its workstations since the mid-1980s. SunOS provides the familiar windows, icon graphics, and mouse that Macintosh users have become accustomed to, although applications running under SunOS don't always have the same look and feel that Mac applications have.

In fact, the Macintosh is the only system that provides a standard windowing look and feel across all its applications. AT&T and many others feel that the success of Unix as an end-user operating system will hinge on its ability to provide a similar look and feel among its applications. To this end, AT&T and Sun have announced their Open Look standard.

Open Look is not a windowing system in itself, but a set of guidelines that describe what the user interface should look and feel like to the end user. Thus, many existing windowing systems that provide facilities for windows, icons, and so on will be able to emulate Open Look. A toolkit written by manufacturers will use the libraries of the desired windowing system so that a programmer writing applications will use only features of the system that are present in the Open Look standard.

The first two windowing systems being adapted for Open Look are X-Windows and the PostScript-based NeWS. The Presentation Manager and Macintosh windows are logical future candidates. The Open Look is purported to be so similar to the Mac environment in its use of icons, scrollable windows, and pull-down/pop-up menus that Macintosh users should be able to adapt in just a few minutes. It is important to note that Apple won't be suing AT&T and Sun, though; Sun has licensed the graphical windowing technology directly from its originators, Xerox Palo Alto Research Center.

---

though AT&T has built Xenix binary compatibility into its recent version of System V. According to Heller, Xenix compatibility isn't really a major advantage at this point: "If it doesn't cost you much, it's worth doing simply because there are some people who want it, but I don't believe it's going to be a major issue in the future." Nevertheless, it is unlikely that Xenix will disappear as easily as PC/IX, given that it claims the largest installed base of Unix machines in the industry.

A Double Standard

IBM has recently joined the Open Software Foundation (OSF), a nonprofit corporation set up to develop an industry-standard computing environment based on Unix. Key players include Hewlett-Packard, Digital Equipment Corp., and Apollo, among others.

The creation of the OSF is in direct response to the AT&T and Sun agreement to provide the industry with a standard Unix platform that will meld Unix System V, Xenix, and SunOS into a unified operating system with Open Look as its interface. (See the text box "Command-Line Unix, Windows, and Open Look" above.)

As this issue goes to press, the OSF has officially stated that its proposed standard Unix will be based on technology contained in a future version of AIX. This probably means version 2.2. Though the OSF has not clearly detailed its plans, it is almost certain that its standard Unix will be System V version 2.0–compatible and will have a user interface based on X-Windows. The announcement is significant because AIX, which has lagged behind other Unix ports technologically, may now find itself in the forefront.

The prospect of having two Unix operating system standards instead of one means that other systems, such as OS/2, could gain an increased market share simply because of Unix factionalism.

However, developers on both sides of the Unix dispute have indicated a willingness to provide compatibility among their systems.

Running in Parallel

Research using the RT PC has pointed out another direction Unix standards might take. One such project uses eight RT RISC processors running in parallel. The so-called Advanced Computing Environment (ACE) supports parallel-processing research. It runs a new version of the Unix kernel developed at Carnegie-Mellon University, called MACH, that exhibits important advances in multiprocessing support.

IBM claims that its ACE-2 high-performance workstation currently under development has 200-million-instruction-per-second (MIPS) performance with the ability to handle interactive three-dimensional graphics on a 2K-byte by 2K-byte (2048 by 2048, or 4 million pixels) graphics display. Technology such as this might be IBM's response to the new breed of super workstations offered by companies such as Ardent and Silicon Graphics.

It's a Contender

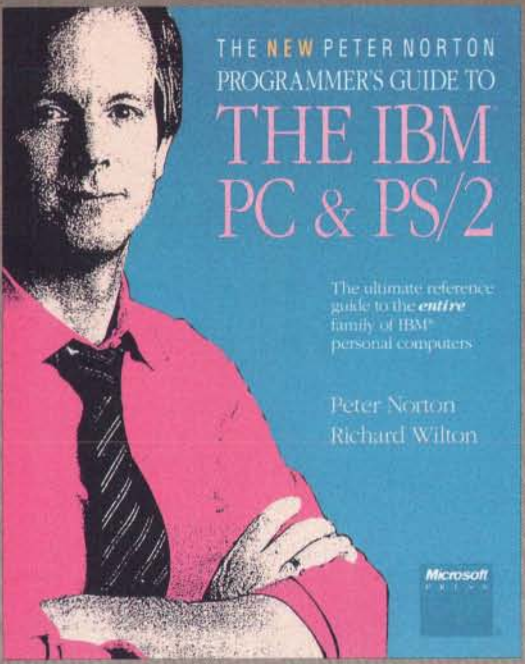
In the long run, IBM views the AIX and the RT PC as its main contenders in the personal workstation marketplace. Heller claims, "We're spending at a rate equal to the rate we spend on PS/2, in terms of engineering, for follow-ons to the RT. But we've also extended our Unix capability through AIX down onto the 80386 PS/2 and up into 370, all the way through ESA [Enterprise Systems Architecture] machines."

With the support of the Open Software Foundation and Heller's contention that IBM is committed to "doubling the performance of the RT RISC–based processor pretty much every year," the RT PC and AIX could make significant gains in the industry. ■

Jason Levitt is a Unix consultant and freelance writer living in Austin, Texas. He can be reached on BIX c/o "editors."

Peter Norton's Best

". . . both a text to be read from front to back and a reference book to sit on the shelf waiting with immediate answers to questions . . . a must for every serious PC user's technical library." ***PC Magazine***



$22.95

THE PETER NORTON PROGRAMMER'S GUIDE TO THE IBM PC has long been a must-have reference for programmers, students, industry experts, even nonprogrammers who want to master the inner workings of IBM microcomputers. Now thoroughly rewritten, THE NEW PETER NORTON PROGRAMMER'S GUIDE TO THE IBM PC AND PS/2 continues to be *the* reference of choice to the new generation of IBM microcomputers—including the PS/2. Accept no substitutes.

Timely New Information

A wealth of updated and new information covers 80286 and 80386 microprocessors; the new PS/2 ROM BIOS; the enhanced keyboard; the new VGA and MCGA; DOS through version 4.0; interrupts, device drivers, and video programming; and programming in C, Microsoft QuickBASIC, and Turbo Pascal.

Unmatched Programming Advice

Norton and Wilton's characteristically astute advice, programming methods, and techniques will help you create simple, clean programs that are portable among all current—even future—IBM machines. You won't find better authorities—their down-to-earth style makes even the most complex concepts readily understandable.

Solid Technical Data

Included is up-to-date information on ROM software; video, disk, and keyboard basics; clocks, timers, and sound generation; ROM BIOS basics and the ROM BIOS services; DOS basics, interrupts, and functions; and much more. Of special interest are the details of the architectural similarities and differences among IBM machines.

Microsoft® Press
Hardcore Computer Books

*Available wherever books and software are sold. Or call in your credit card order **800-638-3030.** Refer to ad BMA8.*

Circle 141 on Reader Service Card (DEALERS: 142)

QNX vs. OS/2 UNIX

QNX®: Bend it, shape it, any way you want it.

ARCHITECTURE If the micro world were not so varied, QNX would not be so successful. After all, it is the operating system which enhances or limits the potential capabilities of applications. QNX owes its success (over 60,000 systems sold since 1982) to the tremendous power and flexibility provided by its modular architecture.

Based on message-passing, QNX is radically more innovative than UNIX or OS/2. Written by a small team of dedicated designers, it provides a fully integrated multi-user, multi-tasking, networked operating system in a lean 148K. By comparison, both OS/2 and UNIX, written by many hands, are huge and cumbersome. Both are examples of a monolithic operating system design fashionable over 20 years ago.

MULTI-USER OS/2 is multi-tasking but NOT multi-user. For OS/2, this inherent deficiency is a serious handicap for terminal and remote access. QNX is both multi-tasking AND multi-user, allowing up to 32 terminals and modems to connect to any computer.

INTEGRATED NETWORKING Neither UNIX nor OS/2 can provide integrated networking. With truly distributed processing and resource sharing, QNX makes all resources (processors, disks, printers and modems anywhere on the network) available to any user. Systems may be single computers, or, by simply adding micros without changes to user software, they can grow to large transparent multiprocessor environments. QNX is the mainframe you build micro by micro.

PC's, AT's and PS/2's OS/2 and UNIX severely restrict hardware that can be used: you must replace all your PC's with AT's. In contrast, QNX runs superbly on PC's and literally soars on AT's and PS/2's. You can run your unmodified QNX applications on any mix of machines, either standalone or in a QNX local area network, in real mode on PC's or in protected mode on AT's. Only QNX lets you run multi-user/multitasking with networking on all classes of machines.

REAL TIME QNX real-time performance leaves both OS/2 and UNIX wallowing at the gate. In fact, QNX is in use at thousands of real-time sites, right now.

DOS SUPPORT QNX allows you to run PC-DOS applications as single-user tasks, for both PC's and AT's in real or protected mode. With OS/2, 128K of the DOS memory is consumed to enable this facility. Within QNX protected mode, a full 640K can be used for PC-DOS.

ANY WAY YOU WANT IT QNX has the power and flexibility you need. Call for details and a demo disk.

THE ONLY MULTI-USER, MULTI-TASKING, NETWORKING, REAL-TIME OPERATING SYSTEM FOR THE IBM PC, AT, PS/2, THE HP VECTRA, AND COMPATIBLES.

Multi-User	10 (32) serial terminals per PC (AT).	**C Compiler**	Standard Kernighan and Ritchie.
Multi-Tasking	64 (150) tasks per PC (AT).	**Flexibility**	Single PC, networked PC's, single PC with terminals, networked PC's with terminals. No central servers. Full sharing of disks, devices and CPU's.
Networking	2.5 Megabit token passing. 255 PC's and/or AT's per network. 10,000 tasks per network. Thousands of users per network.		
Real Time	3,200 task switches/sec (AT).	**PC-DOS**	PC-DOS runs as a QNX task.
Message Passing	Fast intertask communication between tasks on any machine.	**Cost**	From US $450. Runtime pricing available.

QNX

For further information or a free demonstration diskette, please telephone (613) 591-0931.

Quantum Software Systems Ltd. • Kanata South Business Park • 175 Terrence Matthews Crescent • Kanata, Ontario, Canada • K2M 1W8

Circle 182 on Reader Service Card

QNX is a registered trademark of Quantum Software Systems Ltd.

UNIX is a registered trademark of AT & T Bell Labs. IBM, PC, AT, XT and PS/2, PC-DOS and OS/2 are trademarks of International Business Machines. HP and Vectra are registered trademarks of Hewlett-Packard Company.

DOS MEETS UNIX

Can awk and grep coexist with Lotus 1-2-3 and WordPerfect?

Dale Dougherty and Tim O'Reilly

You might regard the news that 80386-based Unix systems can host DOS-based PC applications as a strange development. After all, it's rather like Chevrolet and Chrysler offering Japanese-made automobiles or the British building a bridge over the River Kwai. But can Lotus 1-2-3, dBASE III, and WordPerfect coexist in a multiuser, multitasking computing environment along with Unix utilities like `awk`, `grep`, `make`, and `vi`? Yes they can, but to understand how, you need to understand something about Unix.

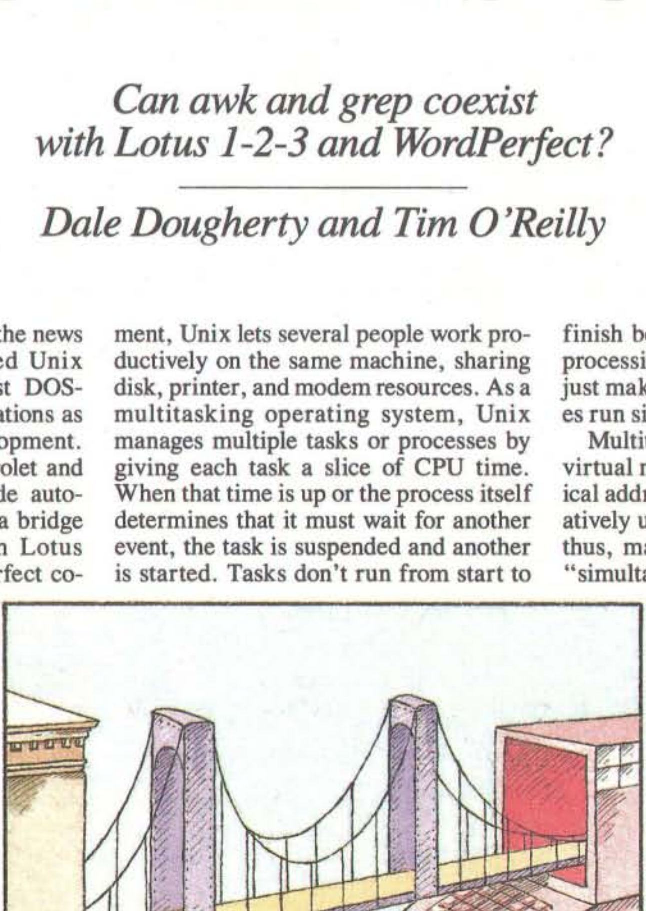
Inscrutable Unix

Unix is the Zen Master of computing. It dispenses a philosophy of "small is beautiful" and teaches you to create your own tools from standard utilities. Much of what Unix does, however, is transparent.

Unix was developed in the early 1970s by researchers at AT&T's Bell Laboratories as a multiuser, multitasking operating system. Today there are two major versions of Unix, AT&T's System V and Berkeley Unix, or BSD 4.3 (Berkeley Standard Distribution).

As a multiuser environment, Unix lets several people work productively on the same machine, sharing disk, printer, and modem resources. As a multitasking operating system, Unix manages multiple tasks or processes by giving each task a slice of CPU time. When that time is up or the process itself determines that it must wait for another event, the task is suspended and another is started. Tasks don't run from start to finish before another is begun, but task processing is interleaved. Multitasking just makes it seem as though all processes run simultaneously.

Multitasking goes hand-in-hand with virtual memory. Rather than using physical addresses, programs operate in a relatively unlimited virtual memory space; thus, many more programs can operate "simultaneously." Unix works with special memory-mapping hardware to transfer small blocks of program data between disk and physical memory as the data is needed, using a "most-used" algorithm to keep disk access at a minimum. If virtual memory hardware is not available, Unix must swap entire processes out to disk when they are suspended—a much less efficient process.



What you see when you use Unix is its user environment. Several shells provide interfaces to Unix utilities and the underlying operating system. In addition, Unix has many general-purpose facilities for file management, print spooling, electronic mail, communications, batch and background job processing, and system administration. If you are experienced, these facilities form a powerful, cus-

continued

ILLUSTRATION: ROBERT KAUFMAN © 1988

tomizable computing environment. In particular, Unix reflects its creators' interests and provides a model development environment for programmers. Because of this, Unix receives wide support from universities and government.

The operating system might have remained isolated in research environments if it weren't so portable. Because it's written mostly in C, Unix is easily ported to a wide range of computer architectures. Consequently, it has become a de facto standard operating system, practically eliminating the development of proprietary operating systems by workstation manufacturers. It is a stable applications platform that's not dependent on a specific hardware configuration.

The PC in Perspective

The enormous quantity of DOS-based microcomputer applications attracts a huge number of users, many of whom would not otherwise use a computer. These users have their own perspectives on computing, based on the applications they use. If Unix has its system gurus, DOS has its application artisans.

DOS application users tend to be practical, get-down-to-business types, who expect the computer to be easy to use and reliable—given a proven application and 12 function keys. Some even seldom use DOS, except to create and examine directories. Nonetheless, users know how to appraise applications and weigh competitive features.

Unfortunately, using DOS applications isn't as simple as it used to be. For example, if you bought a PC to run Lotus 1-2-3 spreadsheets, you probably bought new applications, added graphics boards and extra ports, and purchased tapes, printers, and modems. In addition, you most likely install the software, configure the devices, troubleshoot when things don't work properly, and perform regular backups to protect valuable files.

The time and effort you, and the people you work with, take to perform these duties adds up. Obviously, it's more expensive to maintain personal computer environments now, even though the hardware costs less.

Leading DOS Users to Unix

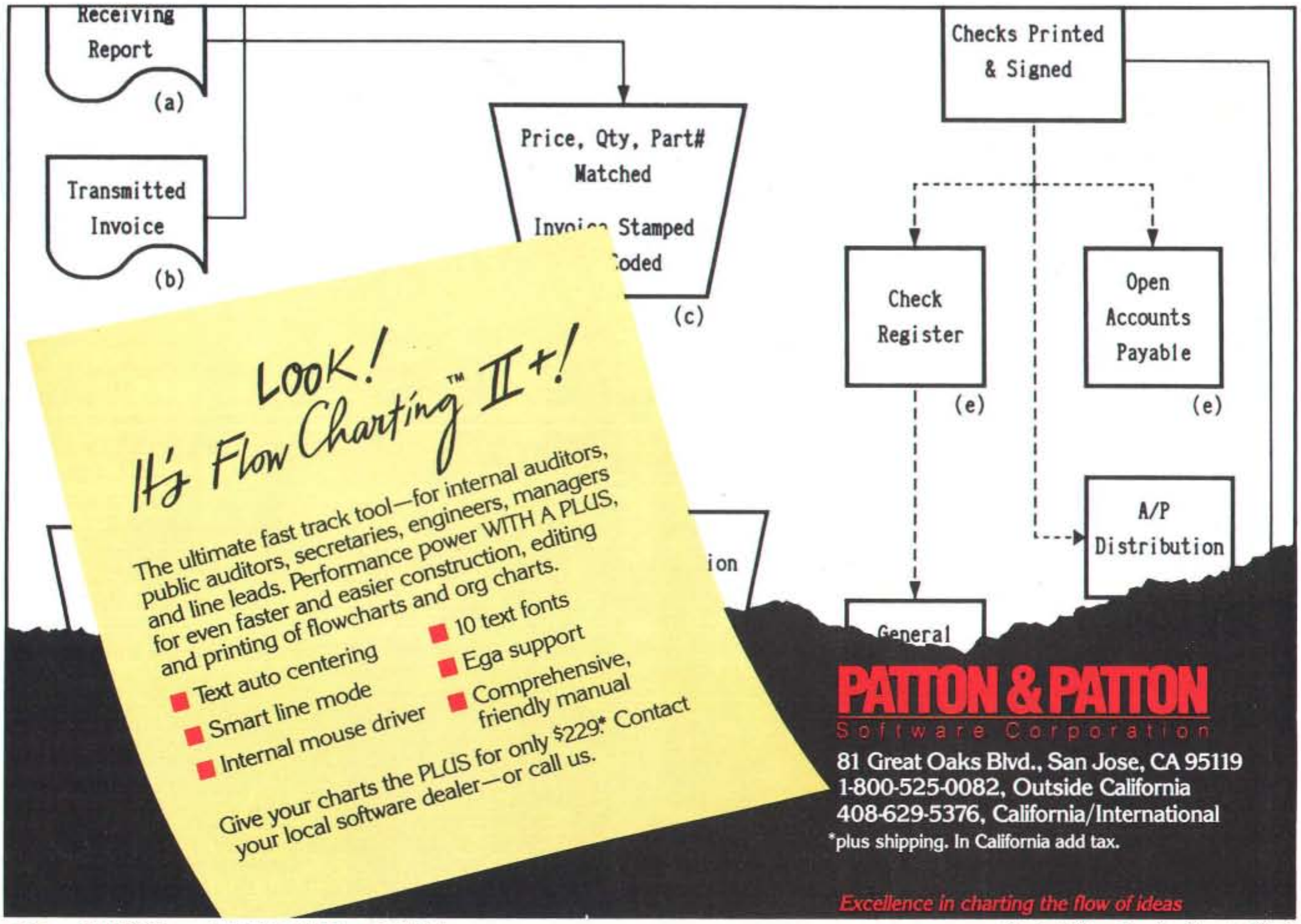
Manufacturers of Unix systems hope that personal computer users are outgrowing PCs and want to lead them into the multiuser Unix market. For example, a Unix computer provides the following:

- A platform for multiuser applications, such as database management, word processing, and communications.
- Centralized data storage and facilities for file security, file system backup, and distributed user access.
- A server that allows you to access multiple printers, modems, tape drives, and terminals.
- Centralized system administration services that perform regular maintenance tasks and monitor system activity.

These features might help persuade PC users that they need an operating system with Unix's features; the hard part is to convince them that they can work as productively in the Unix environment as they do in DOS. New users balk at investing time and energy in learning the Unix environment.

Unfortunately, many people equate the Unix user environment with the Unix operating system. Unix supports a vari-

continued



The ultimate fast track tool—for internal auditors, public auditors, secretaries, engineers, managers and line leads. Performance power WITH A PLUS, for even faster and easier construction, editing and printing of flowcharts and org charts.

- Text auto centering
- Smart line mode
- Internal mouse driver
- 10 text fonts
- Ega support
- Comprehensive, friendly manual

Give your charts the PLUS for only $229* Contact your local software dealer—or call us.

PATTON & PATTON
Software Corporation
81 Great Oaks Blvd., San Jose, CA 95119
1-800-525-0082, Outside California
408-629-5376, California/International
*plus shipping. In California add tax.

Excellence in charting the flow of ideas

Circle 167 on Reader Service Card

NEW

Ecosoft Announces Microstat-II™

Ecosoft developed the original version of Microstat in 1978 and it has grown to become the most widely-used statistics package ever written for a personal computer. **Microstat-II** has been redesigned from the ground up to reflect almost 10 years of user feedback. The result of this synergism is a statistics package that is easy to use, fast, accurate.

Microstat-II has everything for your statistical needs:

- Descriptive statistics: mean, sample-population stardard deviation and variance, moments about the mean, sums, min-max, kurtosis, skewness coefficient of variation, standard error, sums of squares, deviation sums of squares
- Probability Distributions: Binomial, Hypergeometric, Poisson, Normal, Exponential, F, Student t, Chi-square
- Frequency Distributions: value or range, cumulative, percents with bar graph
- Scatterplots: With overlapping points
- Hypothesis testing: mean or proportion, large and small sample
- ANOVA: Oneway, Twoway, Twoway with replication
- Nonparametrics: Wald-Wolfowitz, Cox-Stuart, Kruskal-Wallis, Wilcoxon Rank Sum, Friedman Twoway ANOVA, Kolmogorov-Smirnov (one-two sample), Kendall's Coefficient of Concordance, Spearmans-Rank Correlation, Signs Test, Normal Scores, Mann-Whitney U
- Correlation Analysis: matrix and cross products table
- Regression Analysis: Multiple and Stepwise, forward and backward
- Time Series: moving average, centered moving average, deseasonalization, exponential smoothing
- Permutations, Combinations, Factorials, Contingency Tables and Chi-square

SAMPLE OUTPUT

```
Regression Analysis
LONGLEY.MII: Longley test data from JASA vol.62, pp. 819-41.


Forwards Regression
Proportion:             0  Tolerance:             0  F enter:            0
  F remove:             0

Step:     6         Dependent Variable: Total         Degrees of Freedom:     9

Ind  Var  Coefficient   Std Error    Beta Coeff   F Statistic  Probability

    Index  15.06187227  84.91492577   .046282023       .03146   .863140833
      GNP  -.035819179   .033491008 -1.013746349      1.14387   .312681061
 Unemploy -2.020229804   .488399682  -.537542578     17.11003   .002535092
 Military -1.033226867   .214274163  -.204740692     23.25154   .000944367
 Popltion  -.051104106   .226073200  -.101221114       .05110   .826211796
     Year  1829.151465  455.4784991  2.479664383     16.12737   .003036803

                                                      r^2:    .995479005
         Intercept: -3482258.635                        r:    .997736942
       F-Statistic:  330.2853392                r  (d.f.):    .996603485
    Standard Error:  304.8540736       Proportion Reduced:    .000015805
Std  Error  (d.f.):  373.3684631       Cumulative Reduced:    .995479005

---------------------------  Analysis of Variance  ----------------------------

            Sum of Squares    D.F.   Mean Squares      F Ratio      Probability
Regression    184172401.9        6    30695400.32    330.2853392     4.9840e-10
 Residual     836424.0555        9    92936.00617
  Total       185008826.0       15

------------------  Residuals   Durbin-Watson:  2.559487689  ------------------

 Case   Observed    Expected     Residual      -2s  -1s   0   +1s  +2s

    1     60323.00     60055.66       267.34    |    .    |    .*   |
    2     61122.00     61216.01       -94.01    |    .  * |    .    |
    3     60171.00     60124.71        46.29    |    .    |*   .    |
    4     61187.00     61597.11      -410.11    |*   .    |    .    |
    5     63221.00     62911.29       309.71    |    .    |    .  * |
    6     63639.00     63888.31      -249.31    |    *    |    .    |
    7     64989.00     65153.05      -164.05    |    . *  |    .    |
    8     63761.00     63774.18       -13.18    |    .    *    .    |
    9     66019.00     66004.70        14.30    |    .    *    .    |
   10     67857.00     67401.61       455.39    |    .    |    .    *
   11     68169.00     68186.27       -17.27    |    .    *    .    |
   12     66513.00     66552.06       -39.06    |    .   *|    .    |
   13     68655.00     68810.55      -155.55    |    . *  |    .    |
   14     69564.00     69649.67       -85.67    |    .  * |    .    |
   15     69331.00     68989.07       341.93    |    .    |    .  * |
   16     70551.00     70757.76      -206.76    |    .*   |    .    |
```

Exclusive Features

We have also added features that make Microstat-II the easiest, most flexible statistics package you've ever used:

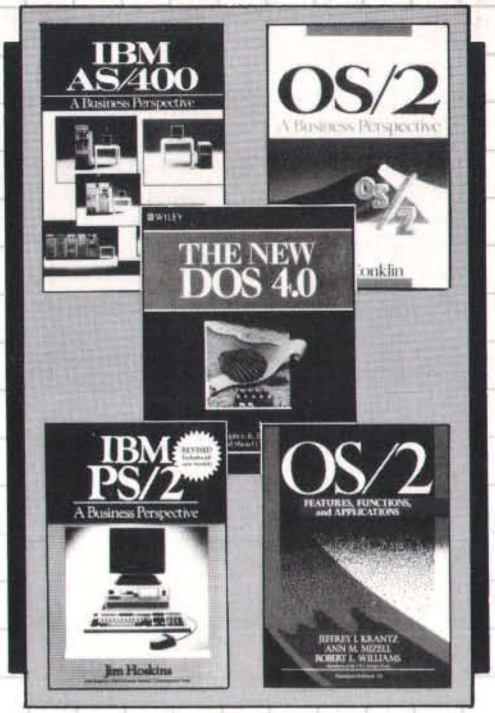
- Up to 8 times faster than older versions of Microstat without any loss in accuracy—up to twice as fast as the competition
- 8087 support
- Online help with a single keystroke and moveable help screens
- No complex command language to learn
- Interactive or batch modes of operation
- Import-export data files
- Keyboard or mouse input
- Scrollable output—review results without rerunning the test
- Configurable—change colors, file types, even set the mouse speed
- Variables may have missing data, aliased values, and unequal sizes
- New data administration: full screen editor for the utlimate in ease of data entry, new transforms (with conditionals) for creating new variables from existing data, range checking, and external file processing
- Expanded user's manual

$395.00.

Ecosoft, Inc.
6413 N. College Ave.
Indianapolis, IN 46220
orders: 1-800-952-0472
info: 1-(317) 255-6476

ECOSOFT

Circle 82 on Reader Service Card



Always the Smart Choice.
IBM insiders put you on the winning track

THE NEW DOS 4.0
Kenneth W. Christopher, Jr., Barry Feigenbaum & Shon Saliga
The design architects for IBM PC DOS Version 4.0 here provide invaluable tips and techniques for getting the most out of this more powerful and versatile new version.
Available October. $22.95

IBM® AS/400
A Business Perspective
Jim Hoskins
The first guide to this long-awaited new generation of mid-size IBM computers, this book gives the complete run-down on employing the AS/400 in the business environment.
Available December. $24.95

IBM® PS/2
A Business Perspective *Revised*
Jim Hoskins
Includes all new models. From a PS/2 development team member who *knows* the IBM Personal System/2—and how to get every bit of capacity out of it. $19.95

OS/2™
A Business Perspective
Dick Conklin
From the ground up, here's how to install, manage, and maintain OS/2 for everyday business use—and make a quick, painless transition from DOS to OS/2. $21.95

OS/2™
Features, Functions, and Applications
Jeffrey I. Krantz, Ann M. Mizell & Robert L. Williams
Here's the inside track from members of the OS/2 design team on harnessing OS/2's unprecedented programming power and manipulating every feature and function of the system. $24.95

WILEY
Wiley works for your computer.
AT YOUR LOCAL BOOKSTORE OR CALL 800-526-5368
605 Third Avenue
New York, NY 10158-0012
In Canada:
22 Worcester Road, Rexdale, Ontario M9W 1L1

ety of user interfaces, including a multiwindow environment. An application running in Unix can present a complete environment in which you never need to access Unix directly.

Moving DOS applications to a Unix system is one way to provide a familiar interface and new capabilities. Ideally, DOS developers will port their applications to Unix, but this is not always an easy task, because some applications were not designed to interface with an operating system on a high level. Until a significant number of these applications are available, however, the Intel 80386 processor offers an attractive opportunity to support off-the-shelf DOS applications on a Unix system.

Creating a Virtual PC

The Intel 80386 chip, when combined with specialized software, creates a virtual PC for running multiple DOS applications under the Unix operating system. To understand how this works, let's take a look at the architecture of the Intel 80386 microprocessor. The 80386 is designed to support four modes of operation and has the ability to switch between modes with very little overhead.

The default operating mode of the 80386 processor is a 16-bit real mode. It provides backward compatibility with the Intel 8086 and 8088, the chips originally used on the IBM PC. In real mode, the 80386 executes the instruction set of the 8086. Thus, the same copy of Lotus 1-2-3 bought for the original PC will run on a new Compaq 386. Unfortunately, real mode fails to take advantage of the more advanced processor. Using the 80386 to run in real mode is like buying a PostScript printer and setting it up to emulate an old dot-matrix printer.

The 80386 also has 16-bit and 32-bit protected modes. The 16-bit protected mode is designed for 80286 compatibility. (OS/2 is being designed to use this mode.) The 32-bit protected mode is the native mode, making the 80386 the most powerful Intel microprocessor. Native mode supports demand-paged virtual memory (a 4-gigabyte virtual address space) and provides privilege mechanisms that make true multitasking possible. Thus, the 80386 is well suited for running the Unix operating system.

In real mode, a DOS application runs in a single-tasking environment where it can do anything it wants, going directly to the hardware level if it desires, without worry that it has to compete with other applications. In protected mode, the processor uses privilege levels to determine which process to execute next. As in any situation where there is a limited resource and multiple opportunities to use it, there must be some priority established for allocating that resource.

The fourth mode of the 80386 is designed to run DOS programs in a multitasking environment. This special mode is called virtual-8086 mode, in contrast to real-8086 mode. In real mode, DOS applications use physical memory addresses, just as they do on the PC. In virtual mode, physical memory is mapped to a 1-megabyte virtual address space. The DOS program continues to think that it is working with actual addresses, but in fact these are being translated to virtual addresses.

Virtual mode also traps instructions that attempt to perform hardware-level operations, such as I/O. A DOS application is typically designed to act as though

continued

THE
CORPOR△TE
SOURCE

BOFFIN

LIMITED

COMPUTERS
HARDWARE
SOFTWARE
PRINTERS

2500 WEST COUNTY ROAD 42 • #5 • BURNSVILLE, MN 55337 • (612) 894-0595

A Small Case For BIG Performance!!!

TOSHIBA

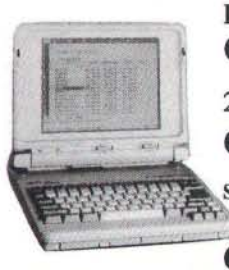
CALL

T1000
T1200F
T1200H
T3100
T3200
T5100

CALL

ZENITH

SUPERSPORT



Dual Floppy
CALL

20 MB HD
CALL

SUPERSPORT
286/20
CALL

MITSUBISHI

New!

MP286L/20

- 11" Diagonal Black & White Display
- 20 MB Hard Disk
- 12 MHz 80286
- 1.4 MB Floppy Drive

Introductory Price

$2695.00

Dual Floppy (1.4 MB) Model
$2195.00

New!

From MegaHertz

Easy Talk 3270
3270 Emulation Card for Toshiba Laptops; Fully supports IRMA & IBM Emulation. Auto-Config. – No Jumper Changes required.
Includes software for 3270 and IND/FILE Transfer Support

$599.00

Easy EGA
EGA Card for Toshiba T1200 and T3100 Laptops. Supports MDA, HGC, CGA & EGA

$299.00

Easy Talk E2400
2400 Baud Modem for the Epson Equity LT

$239.00

Weltec . . .

External 5.25" FDD

$199

Specify TOSHIBA, ZENITH or NEC*

**No cable w/NEC Drive - Cable included in NEC Laptop Box*

MHz INTERNAL MODEMS

1200 Baud **$139** 2400 Baud **$239**

Specify:
Toshiba, NEC EL/HD, Zenith 181/183 or SupersPort

WonUnder
Single card expansion slot for the T1100+, T1200, T3100/20 & T5100 **$299**

Diconix 150P Portable Printer	**$299**
Laplink Plus	**$79**

When Purchased with any Laptop

- **Competitive Price**
- **Corporate Volume Discounts**
- **Net Terms to Qualified Corporate Accounts**

Prices Subject to Change Without Notice

To Order Call:

FAX Number: 894-6175

(800) 255-4012

IN MN: (612) 894-0595

Circle 31 on Reader Service Card

Circle 18 on Reader Service Card

A Unique Way To Upgrade Your Computer. . . *without changing your DOS!*

Just a few minutes with ASTRÖ 3.50" or 5.25" External drives, and you can share spreadsheet, database, and word processing documents created on your PC with IBM PS/2 and most Lap-Top computers.

This isn't just a floppy diskette drive. We've taken the technology a quantum leap further. The ASTRÖ **Internal** or **External** drives actually read, write, and format 1.44Mb, 720Kb, or HP 150 3.50" disks right in your PC *without changing to a New DOS* or complicated *"Bridge files"* network. You can open up a world of new possibilities for your PC through the advanced computers, and you don't have to be a genius to do it.

ASTRÖ 3.50" DRIVE SYSTEMS are compatible with IBM-PC/XT/AT, SPERRY Micro IT, COMPAQ (286/386), AT&T, AST Premium, KAYPRO 2861, TANDY (1000/3000/4000), TOSHIBA and many more . . .

Our ASTRÖ 5.25" External drives are designed to integrate easily into today's high performance IBM PS/2 and TOSHIBA and TANDY 1400LT Lap-Top computers.

Although there are several other drives on the market for **IBM PS/2** models **50/60/80**, there simply is no comparison. ASTRÖ External drives allow you to choose from *360Kb/1.2Mb* or *360Kb* drives, and will **NOT** take an expansion slot, and *our device driver instructs DOS to allow you to change the ASTRÖ drive to become drive B.* For models **25** **&30** with **one** or **two** internal disk drives, our External *5.25" 360Kb* drive is available. **All our External drives have built-in power supplies.**

For your **TOSHIBA 3100, 3200** and **5100** computers, which can be configured as a *3.50" 720Kb/1.44Mb* drive, *5.25" 360Kb/1.2Mb* drive, or as a *5.25" 360Kb* drive.

ASTRÖ was the first to release a *5.25" 360Kb* External drive for your **TANDY 1400LT** computer.

For more details call: Aströ Systems, Inc.

(408) 727-5599/727-7626 • Fax: (408) 727-8149 • 807 Aldo Avenue #106, Santa Clara, CA 95054

OZADLID A. G., LapTop Peripherals, Herostrasse 7, Postfash, CH-8048, Zurich, Switzerland, Phone: 41 1 432 1087, 41 1 432 1085, Fax: 41 1 432 4662

it owns the entire machine, often directly manipulating screen memory or device control registers rather than going through the operating system's BIOS. On a multitasking operating system, such as Unix, these are privileged instructions that must be preempted and held until they can execute safely without interfering with other processes.

When the virtual-8086 mode traps an instruction, the processor switches to protected mode. It doesn't handle the trap itself but relies on a software program called a monitor to handle the problem. The best-known of these programs are Merge 386 by Locus Computing of Santa Monica, California, and VP/ix by Interactive Systems, also of Santa Monica. Primarily, both programs translate the 8086 instruction into a system call that can be handled by Unix. In this way, the 80386 processor ensures that a DOS application running on a virtual PC goes through the Unix operating system to access system resources.

By mapping physical addresses to virtual addresses and trapping hardware-level instructions, the 80386 processor lets a DOS program act just as it always did, without danger of it interfering with other programs or the operating system as a whole. In fact, you can run multiple instances of DOS at the same time, each under the illusion that it owns the entire machine. The emulation is so complete that you can even reboot the virtual machine using DOS's Ctrl-Alt-Del key combination.

A Virtual DOS Environment

While the 80386 chip lets you execute the 8086 instruction set, it doesn't handle all the issues involved in creating an interactive DOS environment on a Unix system. That's where Merge 386 and VP/ix step in. These programs can

- Map the DOS file system onto the Unix file system, including handling differences in file-naming conventions and providing access to hard and floppy disks using DOS drive specifiers.
- Support most ASCII terminals typically connected to Unix systems so that they can run PC programs. For instance, ASCII terminals can display only 24 lines of the PC monitor's normal 25 lines, and many of them lack function keys or special keys such as Alt.
- Map DOS device names to Unix devices or utilities that access these devices. For instance, this would let you send print jobs via LPT1 to the Unix print spooler.

To work in the DOS environment, you must have a Unix log-in account. Once you log in, you can issue a single command to create a DOS environment. You will see the familiar DOS prompt and can use DOS commands just as if they were on a native DOS system.

You can maintain a DOS environment for all or part of a log-in session, or create one just to run a particular application. You can even start the DOS environment from an automatic start-up file so that you log in directly to DOS without ever seeing the Unix prompt. While in the DOS environment, however, you can access Unix commands and files.

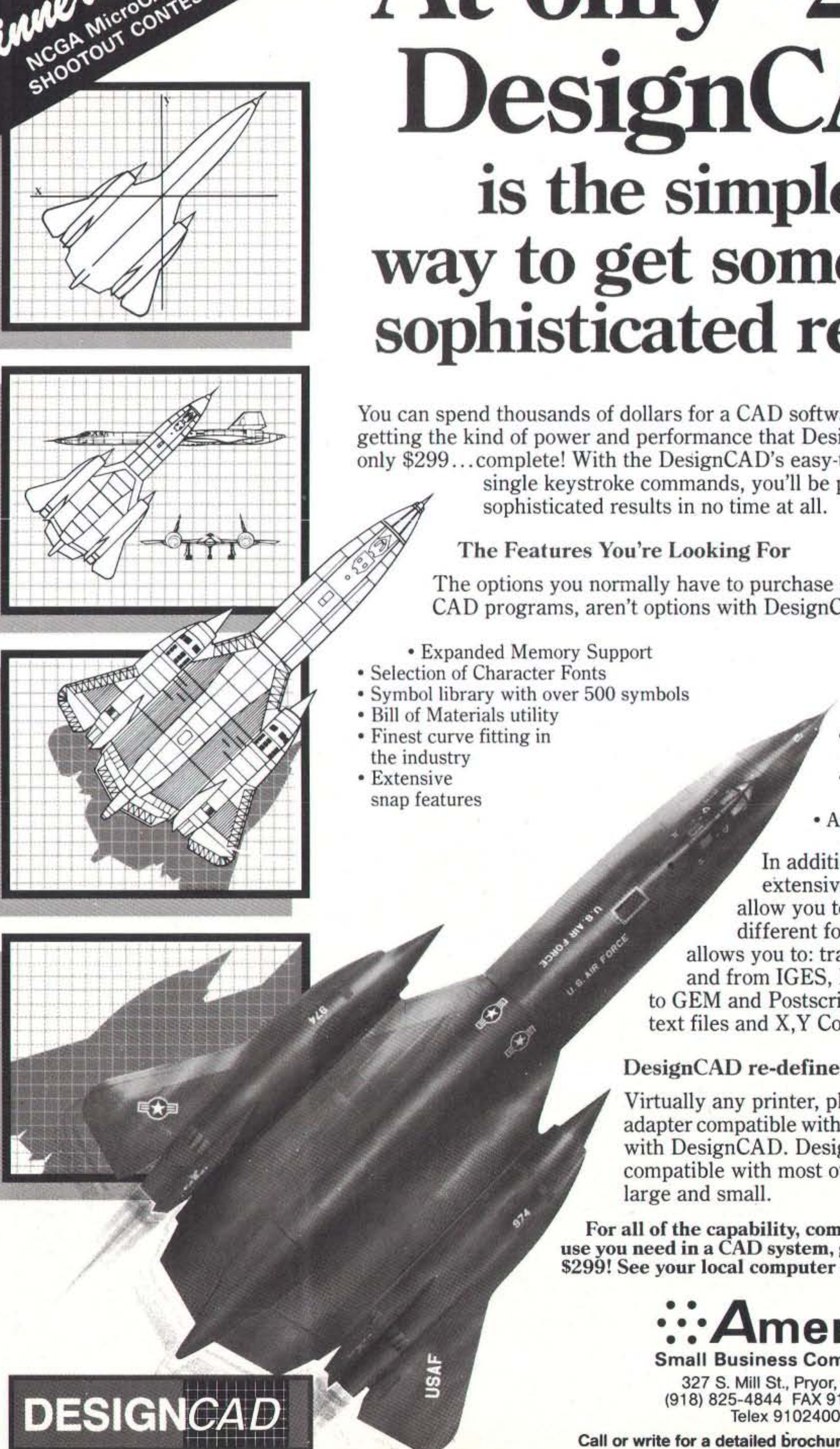
Both Merge 386 and VP/ix can distinguish a DOS command from a Unix command, so you can also execute DOS commands directly from the Unix prompt. If you use Unix, you can freely access DOS

continued

Circle 14 on Reader Service Card →

Winner! 1988
NCGA MicroCADD
SHOOTOUT CONTEST

At only $299, DesignCAD is the simplest way to get some very sophisticated results.



You can spend thousands of dollars for a CAD software package without getting the kind of power and performance that DesignCAD delivers for only $299...complete! With the DesignCAD's easy-to-use, easy-to-learn single keystroke commands, you'll be producing ultra-sophisticated results in no time at all.

The Features You're Looking For

The options you normally have to purchase separately with other CAD programs, aren't options with DesignCAD. They're built in.

- Expanded Memory Support
- Selection of Character Fonts
- Symbol library with over 500 symbols
- Bill of Materials utility
- Finest curve fitting in the industry
- Extensive snap features
- True Auto Dimensioning with several formats
- Extensive layering features
- Full zoom, pan and rotate capabilities
- And many other features

In addition, DesignCAD's extensive file transfer utilities allow you to read and write different formats. DesignCAD allows you to: transfer documents to and from IGES, DXF, HPGL, transfer to GEM and Postscript, and to read ASCII text files and X,Y Coordinate files.

DesignCAD re-defines Compatibility

Virtually any printer, plotter or graphics adapter compatible with IBM PC is compatible with DesignCAD. DesignCAD is also compatible with most other CAD systems, large and small.

For all of the capability, compatibility and ease-of-use you need in a CAD system, get DesignCAD — only $299! See your local computer dealer, or contact:

American
Small Business Computers, Inc.
327 S. Mill St., Pryor, OK 74361
(918) 825-4844 FAX 918-825-6359
Telex 9102400302

Call or write for a detailed brochure and a free demo disk.

DESIGNCAD

utilities and files while retaining the advantages of the multitasking environment. For instance, you can run some DOS applications in the background and have multiple DOS and Unix programs running concurrently.

This means, for instance, that while a spreadsheet is doing a major recalculation or a word processor is printing, you can temporarily leave the application and do other work on the system.

A virtual DOS environment's performance can vary, depending on the system load (the number of users and what kind of work they are doing) and the type of task the application is performing. For instance, a spreadsheet recalculation should be faster than on a PC because it is a direct result of CPU speed. Other tasks involve lots of hardware-level operations that must be trapped; this sort of indirection often reduces performance.

Those Compatibility Blues

DOS applications that run under Merge 386 and VP/ix include popular spreadsheet programs such as Lotus 1-2-3, VisiCalc, and Multiplan, and word processors such as WordStar, Word, and WordPerfect. Most DOS applications are supported, including "ill-behaved" programs—so called because of the clever ways used to write directly to the PC hardware. In addition, some DOS applications employ timing mechanisms that are tuned to the response time of PC hardware. Such applications don't always execute gracefully in a multitasking environment.

> *Most DOS programs can run on an ASCII terminal by emulating the MDA.*

Another point to consider before you bring PC applications to a Unix system is display quality. The standard PC console has a memory-mapped graphic display. Programs draw on the display by writing to a reserved area of memory that is then mapped onto the display. Most Unix ASCII terminals are character-based.

Fortunately, almost all DOS programs support the Monochrome Display Adapter, which is character-based, just like an ASCII terminal. Most DOS programs can run on an ASCII terminal just by emulating the MDA.

But even on an MDA, the PC character set includes special graphics characters that are not part of standard ASCII. Most ASCII terminals can't display these characters. Merge 386 displays them as an asterisk; VP/ix lets you define your own equivalents in a terminal description file.

You can avoid this problem if you have a PC-scancode terminal that emulates the MDA display. It includes the full 25 lines required of a PC display and supports the IBM extended graphics character set. Although this might solve the problems associated with character-based applications, graphics programs like Microsoft's Flight Simulator will run only on memory-mapped displays.

continued

"The best-engineered Multi-Channel Boards on the market today."

Our words? No. Our customers' words. Probably your words, too, after you've inspected a DigiBoard for yourself.

But just as important as our engineering is our engineering support. From multi-point data collection, to factory and office automation, working with multi-user operating systems like XENIX, UNIX, QNX, PC-MOS, PICK, and THEOS, plus DOS and OS/2, we can help you develop more cost-effective solutions for your customers. And more profitable solutions for you.

DigiBoard COM-X Series. Standard multi-channel communications boards with 4 or 8 ports.

DigiBoard COM-Xi Series. Intelligent multi-channel communications boards with 4 or 8 ports, RS-232 or RS-422, providing substantial performance increases over standard boards.

New DigiBoard COM-X Series for PS/2. Standard multi-channel communications boards with 4, 8 or 16 ports for the IBM micro-channel.

DigiBoard OpenEnder™ Intelligent Communications Board shown with a plug-in I/O Mate™ that supports eight asynchronous serial ports plus an optional synchronous port.

New. DigiBoard OpenEnder™ Series for PS/2. Intelligent multi-channel communications boards with plug-in I/O Mates™ to keep your I/O options wide open. Options include RS-232, or RS-422 plus various combinations of asynchronous and synchronous ports.

All of our multi-channel communications boards are available with either DB25 or RJ45 connectors to suit the users' exact requirements.

Software drivers and flexible utilities are provided free with each board for most popular operating systems.

DigiBoard
Plugging you into Tomorrow.

Call 1-800-344-4273. In Minnesota, (612) 922-8055.

Circle 73 on Reader Service Card

Software Developers

Natural selection provides unique passive protection for the porcupine.

The Block -- Natural Selection For Software Protection

Inventor and entrepreneur Dick Erett explains how "The Activator" provides sane protection for your intellectual property.

"In any industry, just as in nature, the process of natural selection raises one solution above another. Natural selection is the most elegant of engineers.

In the area of software protection The Block has been selected by the marketplace as the solution that works. Over 500,000 packages are protected by our device.

For the past 4 years our philosophy has been; *'You have the right and obligation to protect your intellectual property.'*

A New Ethic For Software Protection

In allowing end-users unlimited copies of a software package and uninhibited hard disk and LAN operation, The Block has created a new ethic for software protection.

By removing protection from the magnetic media we remove the constraints that have plagued legitimate users.

They simply attach our key to the parallel port and forget it. It is totally transparent, but the software will not run without it.

A New Technology For Software Protection

Our newest model, The Activator, builds on our current patented design, and establishes an unprecedented class of software protection.

We have migrated and enhanced the circuitry of The Block to an ASIC (Application-Specific Integrated Circuit) imbedded in The Activator.

This greatly improves speed and performance, while reducing overall size. Data protection can also be provided.

Programmable Option

The Activator allows the software **developer** the option to program serial numbers, versions, or other pertinent data known only to the developer, into the circuit, and access it from the program.

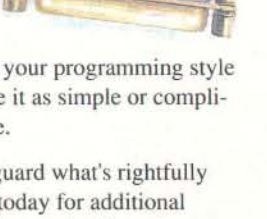
Once you program your part of the chip, even we have no way to access your information.

The ASIC makes emulation of the device virtually impossible. It also presents an astronomical number of access combinations.

Full 100% Disclosure

Since The Activator is protected by our patent we fully disclose how it works. Once you understand it, endless methods of protection become evident.

Just as no two snowflakes are the same, no two implementations of The Activator are identical. And like the snowflake the simplicity of The Activator is its greatest beauty.



We never cramp your programming style or ingenuity. Make it as simple or complicated as you desire.

Let us help safeguard what's rightfully yours. Please call today for additional information or a demo unit. *It's only natural to protect your software.*"

1-800-333-0407
In Connecticut 203-329-8870
Fax 203-329-7428

Software Security inc.

870 High Ridge Road
Stamford, CT 06905

Unlimited Copies • Programmable • Small Size • Fast • Patented • Data Protection

The Block and The Activator are trademarks of Software Security

Circle 213 on Reader Service Card

Circle 122 on Reader Service Card

PowerStation

If you have PCs and VAXes, you NEED these products!

For connecting your PC to a VAX, the PowerStation provides the ultimate solution: a VT200 layout keyboard bundled with sophisticated ZSTEM terminal emulation software.

ZSTEM software includes DEC VT240, VT220, VT100, IBM 3101, TEK 4014 and DG D400 terminal emulation.

"Its performance is as perfect as an emulator can get . . ."
DIGITAL NEWS

For ***true*** terminal emulation call (800) 663-8702.

KEA Systems Ltd.
#412 - 2150 West Broadway
Vancouver, B.C. CANADA, V6K 4L9
Tel: 604-732-7411 Telex: 04-352848 VCR
FAX: 604-732-0715

See us at DEXPO #437

KEA SYSTEMS

SYSTEM SOLUTIONS....
ARE MADE POSSIBLE WITH
QUA TECH

DATA ACQUISITION
Analog I/O: 8, 12, 14 bit A/D, D/A, 72 Digital I/O
COMMUNICATION
Synchronous/Asynchronous
RS422, RS232, RS485, Current Loop
WAVEFORM SYNTHESIZER
Arbitrary Waveform Generation
Digital I/O, Power Control
GPIB (IEEE-488) CONTROLLER

QUA TECH INCORPORATED
478 E. Exchange St., Akron, Ohio 44304
(216) 434-3154 TLX: 5101012726
1-800-553-1170 FAX: (216) 434-1409

Memory-mapped displays require transferring a larger amount of data than is possible with a serial link. (In its high-resolution monochrome mode, an IBM CGA has a resolution of 640 by 200, or a total of 128,000 pixels. At 9600 bits per second, it would take more than 13 seconds to paint the screen.)

To achieve high data transfer rates, you must connect the PC console directly to the processor and memory by a high-speed bus. Sun River's bit-mapped terminal was designed specifically for running DOS graphics applications on a multiuser machine. It is connected to the system with a high-speed fiber-optic link rather than an RS-232 cable.

One 80386-based system designed to support graphics applications is Sun Microsystem's Sun386i workstation. Running its own enhanced version of VP/ix, called DOS Windows, it supports monochrome and color graphics display adapters and monitors with resolutions of up to 1152 by 900 pixels. Software emulates monochrome, Hercules, and color graphics modes. Enhanced graphics display adapters are available for EGA and VGA graphics support. A DOS application runs on the Sun386i in its own fixed-size window, which is a portion of the full-size monitor (up to 19 inches diagonally). You can, for demonstration purposes anyway, have multiple windows running Flight Simulator or AutoCAD at the same time.

The Sun386i will also supply a driver for Microsoft Windows. Applications running under it can use the full screen size of a Sun386i monitor.

The Call of Unix

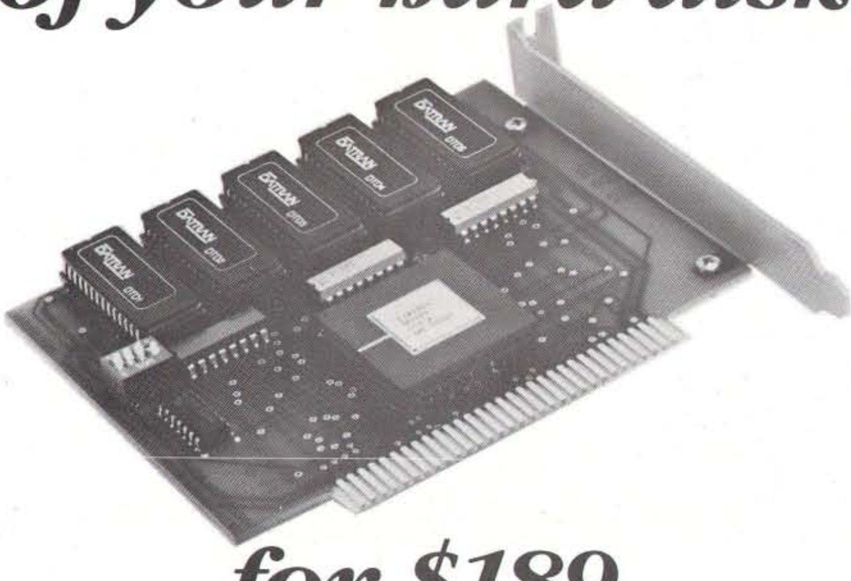
The DOS capabilities provided by the Intel 80386 chip and supported by Merge 386 and VP/ix are meant to entice DOS users and encourage them to migrate to Unix and settle in. But for this to work, DOS users must be convinced of Unix's value and its long-term usefulness.

What's really needed is a DOS-to-Unix bridge; running applications that are targeted for PCs on Unix systems isn't the ideal solution from a design perspective. However, if DOS developers see that users are willing to cross over, perhaps they'll be encouraged to develop DOS-compatible applications that are targeted for Unix. ■

Dale Dougherty is marketing manager and Tim O'Reilly is president of O'Reilly & Associates, Inc. in Newton, Massachusetts. They are coauthors of the Nutshell Handbook DOS Meets UNIX. *They can be reached on BIX c/o "editors."*

Circle 179 on Reader Service Card

New diskdoubler™
doubles the storage capacity
doubles the storage capacity
of your hard disk



for $189

Upgrade the disk drive in your PC the easy way!

Datran's new DiskDoubler dd2000 is a short card that simply fits into any available slot on an IBM, PC, XT, AT, 386 or compatible, DOS 2.0 or greater.

Upgrade a 20 MB disk into a 40 MB. The DiskDoubler lets you double the storage capacity of any hard disk *without loss of performance.* No matter what size hard disk you have, the DiskDoubler will double it.

Works With All Data. The DiskDoubler compresses data stored on a hard disk, including application programs, program files, COM and EXE files. You will appreciate the doubling of capacity for word processing, spreadsheets, and database files.

Powerful dBASE Capacity. The DiskDoubler is especially powerful when handing dBASE II, III and III Plus files, storing on the average *three times* as much data on your hard disk, i.e., your 20 MB hard disk will perform like a 60 MB disk . . . an 80 MB disk will act like a 240 MB model. It works equally well for any size hard disk . . . and for only $189.00.

Principle of Operation. At the heart of the DiskDoubler is a new, powerful high-speed data compression microprocessor that incorporates Datran's state-of-the-art data compression technology, which represents years of research and development.

Totally Transparent Operation. Datran's high speed data compression technology coupled with our extensive operating software allows the DiskDoubler to process data at speeds compatible with disk operating speeds. It looks as though you've added a disk drive of double the capacity to your PC.

Breaks the 32 MB DOS Barrier. Because the DiskDoubler doubles the amount of data your disk drive stores, it effectively increases the 32 MB DOS barrier to 64 MB without any special software.

Simple Installation. Once the simple, fast installation is complete, the DiskDoubler operates in the background and is completely user transparent. The dd2000 works with yours existing hard disk controller.

No Formatting Required as is necessary with RLL controllers. DiskDoubler will even double the capacity of a drive already using RLL technology.

Low Power Consumption. The 1/2 watt DiskDoubler eliminates the need for upgrading your power supply, as would be needed if an additional disk drive were added pulling 15 to 30 watts.

Long Life Performance. With a long three-year limited warranty, DiskDoubler is a simple, inexpensive and reliable way to double your disk storage.

Satisfaction Guaranteed. Datran backs the DiskDoubler with s 30-day no questions asked money back guarantee.

FOR THE DEALER NEAREST YOU OR
TO ORDER DIRECT BY PHONE:

MasterCard VISA **1-800-332-0456**

DATRAN

Leadership in Data Compression Technology

Datran Corporation/2505 Foothill Blvd./La Crescenta/CA 91214/Phone (818) 248-8780/FAX (818) 248-8788/Telex 4932115/TurboCom (818) 248-8789

IBM PC, AT AND DBASE II, III AND III PLUS ARE THE TRADEMARKS OF THE RESPECTIVE OWNERS.

INTRODUCING

Incra®

THE **INCREMENTAL** ASSEMBLER DEVELOPMENT ENVIRONMENT

a Revolution in Assembler Programming

A complete, integrated macro assembler development environment for the 8086 family of processors under DOS. Including a powerful window-oriented source debugger, syntax checking editor, fast linker, and the FIRST INCREMENTAL ASSEMBLER.

Other assembler development cycles look like this:

Edit Program ↘ Assemble ↓ Correct Syntax Errors ← Reassemble ↖ Link ↗ Debug ↗ Edit Program

Cycle Time: 2-20 minutes (or more)

The INCRA development cycle looks like this:

Edit ↔ Debug

Cycle Time: Less than 1 Second!

With other systems, the development cycle for large programs can take several minutes involving a lot of tedious hopping from one program to another. The INCRA Assembly development environment is completely integrated, everything you need to develop assembler programs or routines for programs in other languages, is available at the touch of a key. With INCRA you go from program entry and editing to debugging instantly because the INCRA assembler is INCREMENTAL. It updates the executable code as soon as you change the source – in milliseconds. And the powerful INCRA debug window is always available at the push of a key to trace through the program. If you find a mistake, just flip to the editor and correct it, then flip to the debugger and continue testing.

The INCRA editor checks your assembler syntax as you enter, giving intelligent error messages that make it clear what was wrong and how to fix it – you never have to worry about waiting 5 minutes for a program to assemble, only to find you have to do it all over because you forgot to put in a comma! INCRA also contains a fast, integrated linker that can quickly pull in procedures from other modules and libraries at the push of a button. The INCRA incremental assembler works just as well on linked programs as on single modules, so you can develop large, multi-module programs, and mixed language programs with ease. And with INCRA, macros expand as soon as you enter them, no need to wait for assembly to see if the macro expanded the way you thought it would! If there's a mistake, just edit the macro call, and the macro will immediately reflect the changes.

If you're a serious programmer working with assembler, INCRA's power and speed will make your life easier. If you're just learning assembler, INCRA's ease of use will make it exciting and fun!

If you've always thought of assembler programming as slow, time-consuming, complicated and tedious, wait till you get your hands on INCRA. You'll be saying assembler development with INCRA is Fast... Efficient... FUN!

$180.00 U.S.

If you do any assembler programming at all...
Incra is the tool to use.

SYSTEM REQUIREMENTS: IBM® PC OR COMPATIBLE WITH 256K

Incra Features:

Incremental Assembler
- ☆ Complete macro assembler
- ☆ Supports 8086/88, 80186, 80286, 8087, 80287
- ☆ Also operates in batch mode (faster than MASM 5.0)
- ☆ Compatible with MASM 5.0 (will assemble most MASM 5.0 programs without changes)

Editor
- ☆ Full Screen, fully featured
- ☆ Syntax checking
- ☆ Automatic **INCREMENTAL** assembly
- ☆ Customizable Options
- ☆ Unique line buffer for moving and re-ordering lines
- ☆ Super fast search and page
- ☆ Instantly generates .exe and .obj files
- ☆ Template program files
- ☆ Lots more!

Debugger
- ☆ Window-oriented – see all data, registers, flags, and executing source lines (with comments) at a glance
- ☆ Fully symbolic (no need to declare publics)
- ☆ Single step, multiple breakpoints, conditional breakpoints, check-trace
- ☆ Highlights changes to registers, flags & data at each step
- ☆ Powerful symbolic data display options
- ☆ Save and restore data display definitions
- ☆ Dissassemble with symbolic names
- ☆ Flip to and from your program's display screen
- ☆ Lots more!

Linker
- ☆ Faster than MASM 5.0
- ☆ Link incra files, regular .obj files, and libraries

Macros
- ☆ Full macro capabilities
- ☆ Macros can be instantly expanded in the editor to inspect resulting source
- ☆ Full conditional assembly is supported

Calculator
- ☆ Available at all times
- ☆ Complete set of arithmetic and logical operations
- ☆ All program constant and offset values are available as operands
- ☆ Hex, decimal, octal, binary, ascii results and operands accepted

Options
- ☆ Change environment features such as screen colors, cursor type, tabs, processor type, etc.
- ☆ Save options permanently

Help
- ☆ Pop-up command descriptions available at all times

To order: Call (U.S.A. or Canada)
1-800-387-8722
or send check or money order to:

daystar COMPUTING

25 Warrender Ave., Suite 909
Islington, Ontario Canada
M9B 5Z4
(dealer inquiries welcome)

Circle 68 on Reader Service Card

GRAPHICS: THE BIG PICTURE

IBM's open architecture has taken us from monochrome to stunning graphics displays—with a few stops in between

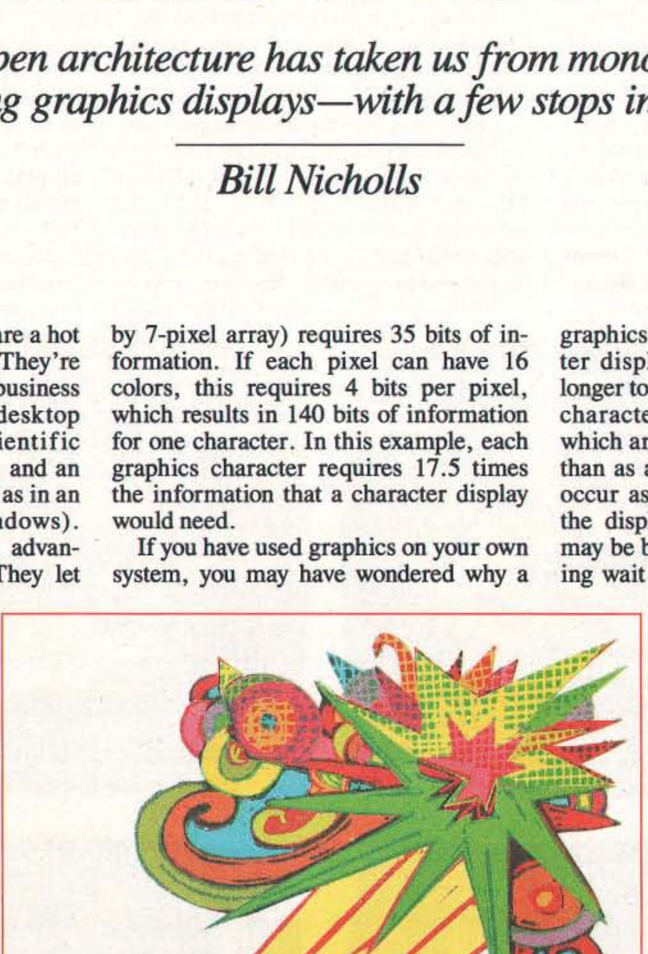
Bill Nicholls

Graphics displays are a hot issue these days. They're used heavily in business presentations, desktop publishing, scientific analysis, some word processors, and an operating system (OS/2), as well as in an operating environment (Windows). Graphics displays have two big advantages over character displays: They let you put more information on the display, and they let you draw arbitrary shapes, with blended colors (on a color monitor).

The question is, why aren't graphics displays universal? They would seem to be the logical display device for almost all uses. However, there are two obstacles to universal use of graphics displays. One is the cost of the controller and the display monitor; the other is the demands that a graphics display puts on the host processor.

These demands come from two requirements of graphics: The computer has to keep each pixel separately in memory, and it has to process and display each one. A character display requires only 1 byte (8 bits) per character, while in a graphics display, a character in the lowest resolution (a 5- by 7-pixel array) requires 35 bits of information. If each pixel can have 16 colors, this requires 4 bits per pixel, which results in 140 bits of information for one character. In this example, each graphics character requires 17.5 times the information that a character display would need.

If you have used graphics on your own system, you may have wondered why a graphics display is slower than a character display. A graphics display takes longer to display characters because each character represents multiple pixels, which are processed one at a time rather than as a character unit. Further delays occur as there are more CPU writes to the display memory, and the memory may be busy refreshing the display, adding wait states to the CPU write. Thus, the advantages of graphics to the user also place a burden on the system's performance.



Despite the extra computation involved, the benefits of graphics displays generally outweigh the costs. The initial solution to the speed problem used to be simple—get a faster processor. This worked for a while, until programs grew to need all the processor's time, and the display resolutions grew.

A Graphic History

The original IBM PC treated graphics as an afterthought. IBM recommended the Monochrome Display Adaptor (MDA), which had neither color or graphics. If you were in the (supposed) minority who wanted graphics, you could get the CGA, with 320 by 200 pixels in four colors,

continued

ILLUSTRATION: RANDALL ENOS © 1988

or 640 by 200 pixels in two colors. Text display was coarse but legible.

Hercules Computer Technology made its mark by quickly offering a text/graphics compromise of good text resolution and 720- by 348-pixel monochrome graphics. This became the default standard that the MDA should have been. Years later, IBM responded with EGA, then a big step forward with 640 by 350 pixels and 16 colors. But the EGA card was expensive. Sooner than expected, the clone makers copied the function of the EGA, extended its capabilities, and got the prices down to competitive levels. Now the EGA is considered a basic display standard. VGA followed later, correcting some EGA weaknesses and raising the resolution standard to 640 by 480 pixels with 16 colors. (Just to confuse the issue, there's also the PS/2's CGA-compatible MCGA—Multicolor Graphics Array—which has the VGA's 640 by 480 pixels but can display only two simultaneous colors at that resolution.) A standard VGA displays 2.4 times as many dots as the original CGA display and requires 9.6 times as much memory for internal storage. (See photo 1.)

While the above activity was happening in the IBM PC arena, other companies developed computers that had graphics as a basic element of the system. The Mac came out with a 512- by 342-pixel black-and-white display, with standard graphics routines in ROM. The Amiga 1000 started with 320 by 200 and 640 by 200 graphics, plus hardware support that improved graphics performance. The Atari ST machines also included graphics at the start, and Atari later added hardware support. It was clear from these events that the need for graphics extended beyond just IBM PC users.

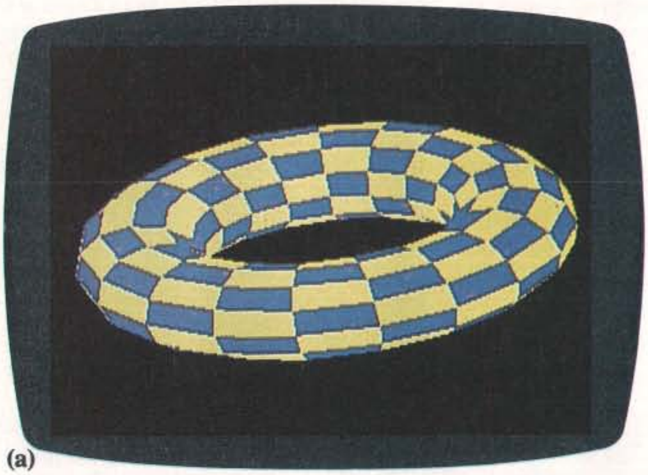
Although the first PC graphics were crude by today's standards, they opened a window into a new class of applications. However, shortly after the first graphics applications became available, problems popped up. Speed was less than impressive, especially on a 4.77-MHz PC. The limited number of colors and low resolution available on CGA seriously restricted detail that could be presented and provided limited eye appeal.

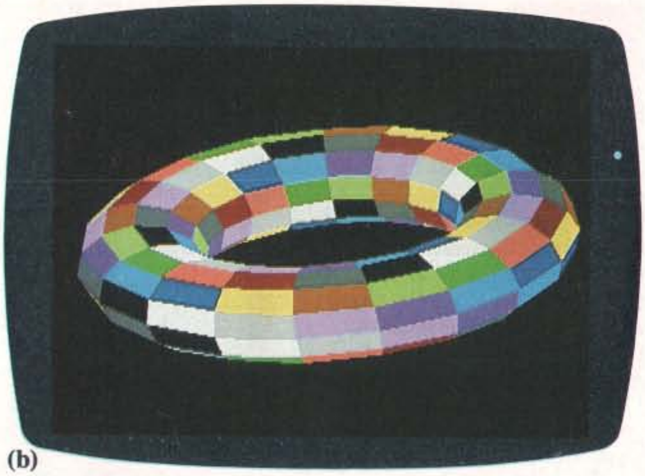
While the EGA overcame the color/resolution limitation, it worsened the speed problem. The CGA's 32K-byte video memory became a 112K-byte memory, and the EGA required five out of six memory cycles to be dedicated to display refreshing, which reduced the access speed to display memory. On top of that, EGA required that the CPU access the four memory planes of display memory one plane at a time. The complication required four accesses where one had done the job before.

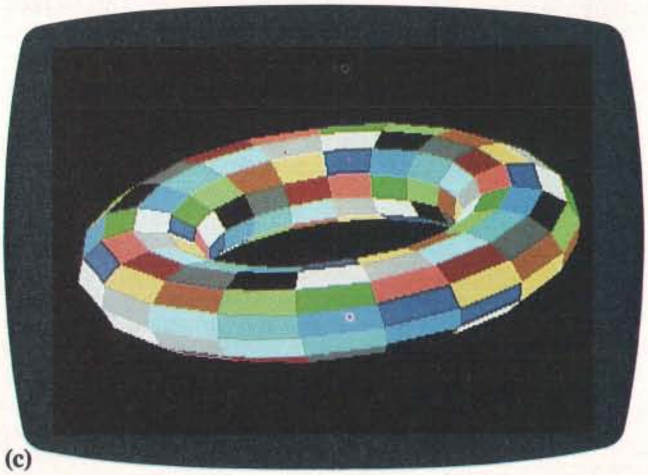
Problems with Programming

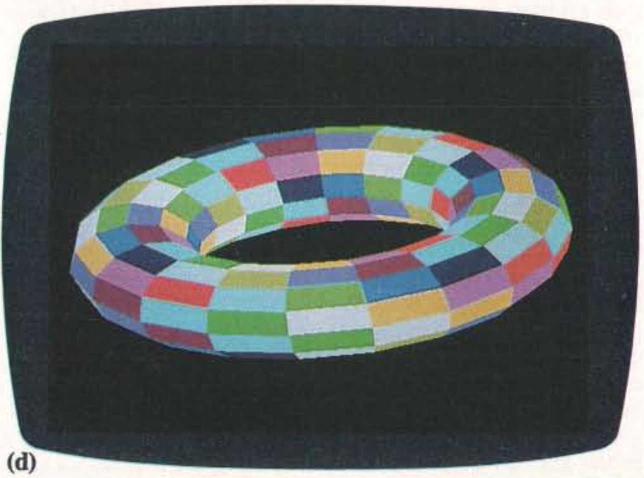
In addition to speed problems, the EGA came with new programming requirements. Software vendors had to support the three major displays (CGA, Hercules, and EGA) to sell to the whole market, and all three required different techniques for best speed. Graphics speed is critically dependent on code quality, so all graphics support was done in assembly language, which increased programming difficulty still further.

Some new problems also had to be handled. The EGA had some registers that were write-only. Once set, they


(a)


(b)


(c)


(d)

could not be read back later to see what the status was. This meant that programs had to keep (in low memory) information that specified what those registers contained. But not all software used or updated that information, thus creating incompatibilities, especially with terminate-and-stay-resident (TSR) programs. Another problem was the EGA's vertical retrace interrupt. Some programs used the vertical retrace interrupt to trigger actions, only to find out that not all EGA implementations handled it correctly, because of errors in IBM's published specifications.

While software vendors were tearing out their hair, users were demanding more speed and resolution. These made the display more attractive and useful but made the software vendors' job more difficult. Even with an 8-MHz AT, graphics displays were far from the instant update that a character display could deliver. Users wanted both—speed and graphics.

The Standards Dilemma

Along with all the other issues, various committees and manufacturers were developing standards for writing and displaying graphics and, later, standards for the interchange of graphics. Instead of one or two standards that could have advanced the industry, forces pulled in all directions:

- In order to have a standard, you need lots of products to sell the standard. In order to have products, you need a standard.
- To efficiently drive CGA, EGA, and Hercules, you need standards oriented to the hardware. To support programming efficiently, you need standards oriented to software.
- By promoting your own standard, you could gain a marketing edge, at the cost of compatibility and a proliferation of standards. If you wanted to support a standard, would you wind up supporting a competitor?

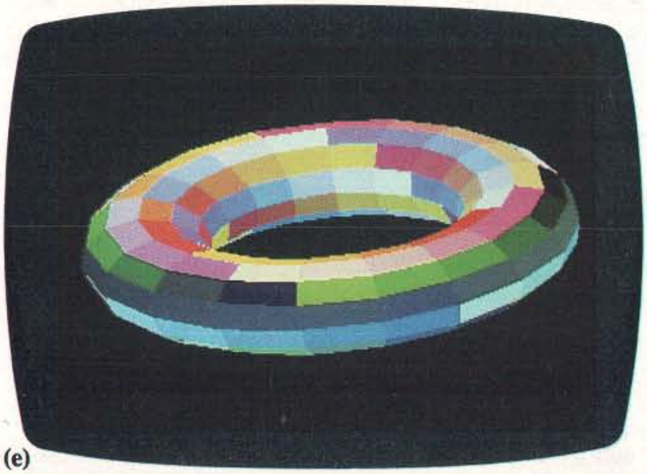
The result of these dilemmas was that literally dozens of graphics "standards" became available, ranging from single-product standards to the IEEE Computer Graphics Metafile (CGM). Only in 1988 have we seen the beginning of a resolution to the standards dilemma, which will likely take until 1990 to become pervasive. Even then, there will be more than one standard, but there should be few enough to be manageable.

Graphics Processors

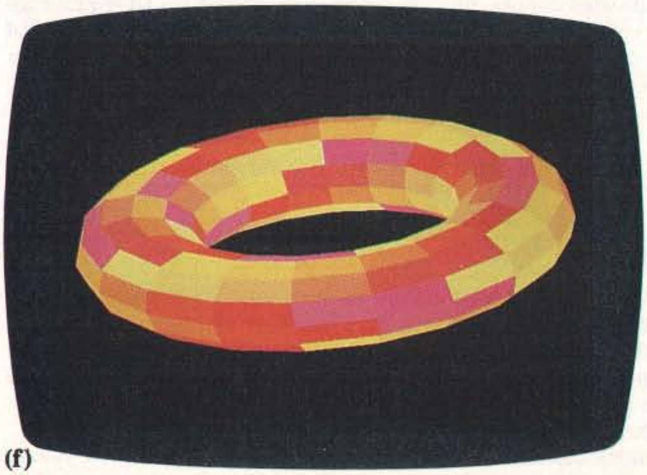
As resolution and the number of colors increased and users demanded more speed, even the faster processor solution failed. It wasn't just speed that was the problem—good graphics requires a lot of programming as well as speed. Fortunately, by this time some of the basic graphics functions were well established, and these functions became the hardware nucleus of a new class of processors known as graphics processors.

GPs take the basic graphics operations and implement them in hardware, doing in one processor cycle what may have taken a software implementation several instructions and 20 or more cycles. GPs also add certain useful functions, particularly the bit-block transfer, known as BitBlt. This operation can take an arbi-

continued



(e)



(f)

Photo 1: *This series of graphics, generated on an IBM PS/2 Model 80 with an 8514 color monitor, shows how far IBM graphics have come in a few short years.*

(a) *The CGA, capable of up to 4 colors in 320 by 200 resolution (here) or 2 colors in 640 by 200 resolution.*

(b) *The EGA, displaying 16 colors in 320 by 200 resolution.*

(c) *The EGA, displaying 16 colors in 640 by 200 resolution.*

(d) *The EGA, displaying 16 colors in 640 by 350 resolution (256K bytes of system RAM).*

(e) *The Multicolor Graphics Array, capable of 256 colors in 320 by 200 resolution (here) or 2 colors in 640 by 480 resolution.*

(f) *The Video Graphics Array, capable of up to 16 colors in 640 by 480 resolution.*

trary group of bits anywhere in memory and move them anywhere else, without being restricted by byte or word boundaries. Since graphics pixels are bit-oriented units, BitBlt enabled simple and rapid movement of graphics entities on the screen.

Two complementary factors helped reduce the cost barrier on graphics displays. On the technical side, mass production reduced the cost of chips and displays, and increasing semiconductor integration reduced the number of components while adding to their function and performance. On the human side, a number of management studies showed that graphics and fast response led to increased user productivity.

The combined cost push and management pull led to changing the evaluation of graphics displays. No longer an expensive toy, graphics displays became a key productivity tool. This helped fuel a rapid evolution in software and hardware that continues unabated today.

Evolution of the GP

One of the first GPs for PCs was IBM's PGA, which used an Intel 8080 processor and provided 640 by 480 resolution with 256 colors from a palette of 4096. Although the concept was correct, the price and performance were poor, and the PGA had only limited success. However, the ground was broken, and other controllers using a processor were introduced. Another early controller used the Hitachi 7220 chip, which was faster than the PGA but was limited in what it could do compared to a general-purpose processor.

Along with the extra processor capability came a new requirement. Each new GP had a different software interface with the host processor. In order for the GP to do more than just set single dots, applications need a software protocol between the HP and the GP that enables the HP to specify what the GP is to do. This means that for the GP to draw a line, the HP must pass the start, end, color, width, and form of the line in a manner that the GP can interpret. This forced each graphics application to write new code for each display controller that used a different interface.

As GP controllers arrived on the market, the combination of GPs and CGA, EGA, and Hercules caused the software problem to rapidly become too expensive for all but the largest software vendors. What followed was an explosion of incompatible products, incompatible software interfaces, multiple graphics software "standards," immense confusion for the general user, and duplication of effort almost everywhere graphics was developed or used.

Recently, however, the graphics environment has begun to stabilize. Microsoft Windows 2.0 and OS/2 Presentation Manager are establishing a set of conventions for applications to have a single interface to a virtual graphics device, with the operating system and environment dealing with the different interfaces to the display controllers, with or without a GP. Windows 1.0 was designed without taking the capabilities of GPs into account, and, as such, did not show significant performance increases when a GP was used (see "High-Performance Graphics Boards," January BYTE). Windows 2.0 was changed to make more effective use of GPs.

In addition to those environments, the third-party software market has begun to organize around a number of well-supported graphics drivers, such as MetaWindow, and the software tool makers have added graphics support to products like Turbo Pascal 4.0. Third-party software tool vendors like PMI are moving to support the Microsoft Windows and other window interfaces as an option with their products. The IEEE is nearing completion on a number of graphics standards, such as CGM, that have broad nonpartisan support.

All these products and standards recognize, to a greater or lesser degree, the need for an effective interface to graphics processors. This recognition has spread in 1988 so that future products will more likely support the GP interface effectively.

Performance

GPs mean higher performance for the user now, and even more in the future. In today's systems, a GP will show varying performance improvement. This will range from little or none while emulating current standards, to several times for graphics-intensive programs that match the GP's interface. CAD and desktop publishing have already benefited from early use of GPs.

Even if you're not a CAD or desktop publishing user, there are benefits for you. GPs can reduce the load on the host processor, making programs run faster and letting you increase the screen resolution without a corresponding slowdown of the host processor. Future displays with higher resolutions will let you display multiple windows simultaneously, making it more practical to watch and work with more than one program at a time. Higher resolutions and GPs also make it possible to use higher-quality text fonts. These fonts reduce eyestrain and improve the working environment, factors that are becoming increasingly important to everyone.

What's in It for You?

Most users today don't use GPs in their systems. The reasons for this range from cost and availability to need and software support. But things are changing rapidly, and most users should begin planning for the probable use of GPs.

What needs to be done? First, you should be aware of a few trends. The price of graphics technology continues to go in a downward direction, despite occasional glitches. The resolution and colors available continue in an upward direction. More and more software uses or supports a graphics interface. These trends are expected to continue, and all of them point to more graphics for the user.

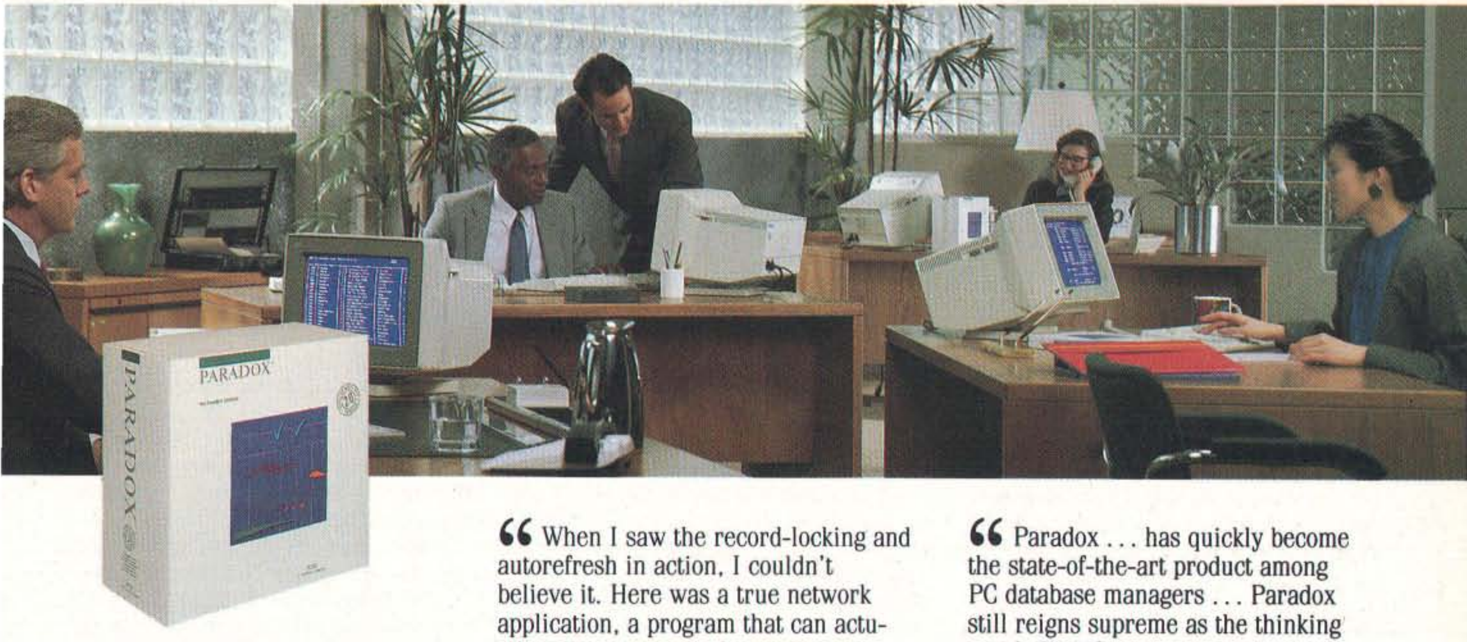
If you accept that graphics is the coming display environment, what can you do to prepare? Start by reviewing what software you have and whether it operates in character mode, graphics mode, or both. Find out what resolutions and controllers it supports, and look particularly for support of graphics processors. Make up a list showing these facts and organize the list by the time it spends in each application.

Now consider your upgrade options. Are graphics versions of your software available, or have they been announced? Are there other products for this application that offer better options? Consider what other applications you might want to add in the future, and what graphics options are available for each of these. Make a list of the software and environment you would like to evolve to.

Turning to the hardware side, take a similar inventory. If you have an older machine, particularly an IBM PC, consider a system upgrade to at least a fast AT or 80386SX machine. Check your display controller and display. If you're running EGA or better, there may be no need for an immediate upgrade. If not, then budget and timing will determine the next step. If your budget can handle it, you can upgrade to a new GP controller now. If both the budget and time frame are short, avoid the EGA even if it looks inexpensive. VGA-compatible controllers are downward-compatible with EGA, without the EGA weaknesses. VGA is *not* a graphics processor, but it represents the current best value for non-GP graphics controllers.

continued

Why Paradox 2.0 makes your network run like clockwork



Paradox® runs smoothly, intelligently and so transparently that multiple users can access the same data at the same time—without being aware of each other or getting in each other's way.

With Paradox news travels fast and it's always accurate

Paradox *automatically* updates itself with a screen-refresh that ensures that all the data is up to date and accurate all the time. Record-locking, Paradox-style, safeguards data integrity by preventing for example, two different users from making changes to the same record at the same time.

How to make your multiuser network work

To run Paradox 2.0 or the Paradox Network Pack on a network, you need:

- Novell with Novell Advanced Netware version 2.0A or higher
- 3Com 3Plus with 3Com 3+ operating system version 1.0, 1.1 or higher
- IBM Token Ring or PC Network with IBM PC Local Area Network Program version 1.12 or higher
- Torus Tapestry version 1.45 or higher
- AT&T Starlan version 1.1 or higher
- Banyan VINES version 2.10
- Other network configurations that are 100% compatible with DOS 3.1 and one of the listed networks

System Requirements for the Network Workstation

- DOS 3.1 or higher
- 640K RAM
- Any combination of hard, floppy, or no disk drives
- Compatible monochrome, color, or EGA monitor with adapter

*Customer satisfaction is our main concern; if within 60 days of purchase this product does not perform in accordance with our claims, call our customer service department, and we will arrange a refund.

Paradox is a registered trademark of Ansa Software. Ansa is a Borland International Company. Other brand and product names are registered trademarks or trademarks of their respective holders. Copyright ©1988 Borland International. BI 1243

“When I saw the record-locking and autorefresh in action, I couldn't believe it. Here was a true network application, a program that can actually take advantage of a network to provide more features and functions, things that can't be done with a standalone PC.

Aaron Brenner, LAN Magazine

With Version 2.0, Paradox becomes a sophisticated multiuser product that boasts an impressive selection of data-production features and password-security levels.

Rusel DeMaria, PC Week”

Paradox responds instantly to "Query-by-Example"

The method you use to ask questions is called Query-by-Example. Instead of spending time figuring out *how* to do the query, you simply give Paradox an example of the results you're looking for. Paradox picks up the example and automatically seeks the fastest way of getting the answer.

Queries are flexible and interactive. And in Paradox, unlike in other databases, it's just as simple to query more than one table as it is to query one.

“The program elegantly handles all the chores of a multiuser database system with little or no effort by network users.

Mark Cook and Steve King, Data Based Advisor”

“Paradox ... has quickly become the state-of-the-art product among PC database managers ... Paradox still reigns supreme as the thinking user's DBMS.

Jim Seymour, PC Magazine”

You don't have to be a genius to use Paradox

Even if you're a beginner, Paradox is the only relational database manager that you can take out of the box and begin using right away.

Because Paradox is driven by the very latest in artificial intelligence technology, it does almost everything for you—except take itself out of the box. (If you've ever used 1-2-3® or dBASE,® you already know how to use Paradox. It has Lotus-like menus, and Paradox documentation includes "A Quick Guide to Paradox for Lotus Users" and "A Quick Guide to Paradox for dBASE users.") Paradox, it makes your network work.

60-Day Money-back Guarantee*

For a brochure or the dealer nearest you
Call (800) 543-7543

BORLAND
INTERNATIONAL

Circle 36 on Reader Service Card (DEALERS: 37)

Given enough lead time, budget for a GP-based controller. Plan your software upgrades around the goal of graphics support that meets your needs, and your hardware upgrades to give you the performance you want.

Obvious candidates for GP-based controllers are CAD and desktop publishing. There are a number of less obvious candidates as well. Consider the high-end word processors. Most now support graphics preview of the finished page. Viewing the page on the screen is a lot faster than printing it and then trying to change the results. WYSIWYG depends in part on what you *can* see. Good graphics support can be a productivity aid for almost anything beyond the basic business letter.

Business graphics and analysis programs that use graphics as a primary output are other applications that can benefit from improved graphics capability. A column of numbers is harder to interpret than a graph and takes longer to read. While printing a graph is slow, a spreadsheet displayed as graphics output takes best advantage of the human ability to spot trends and exceptions. Again, user productivity is improved.

Finally, consider the programmer. His or her desk is usually covered with paper because he or she can't get enough on the screen at one time. With a high-resolution screen and a large display, you can open multiple windows at once, which facilitates quicker analysis, or multiple operations at once in a multitasking environment. Both mean greater productivity.

What Is a GP?

A GP is used to process data from internal form to pixels. It may be a standard CPU, a CPU with both standard and graphics instructions, or a custom device solely for the purpose of transforming data to pixels. Some of these might also produce a pixel output stream for direct transmission to a display unit.

GPs are oriented toward the pixel, not the data byte. Pixels are usually represented as 1 to 32 bits of information that might or might not begin on a byte boundary. A general-purpose processor must use extra instructions to manipulate non-byte-size pixels, and this takes extra code and time.

A window (a defined area on the display screen) is a logical element for a GP to handle, easing the load on the HP. Some GPs, like the Intel 82786, have hardware support for window operations, which speeds up the window displays and moves. Other GPs, like the Texas Instruments 34010, have no hardware support for windows but have special graphics instructions that speed up all graphics processing.

The earliest GPs were simply standard processors that were dedicated to doing graphics work. Even though this was a simple approach, it was effective because it brought more processing power to the system and allowed the HP to proceed while the GP drove the display. The GP removed the graphics calculations from the host and, in many cases, wrote directly to its own memory, avoiding other delays. The net effect was a real increase in capability.

Despite the early success in the use of a standard processor dedicated to graphics, second-generation designs rapidly ran into a bottleneck during graphics calculations. Even simple line drawing be-

continued

All the Power of A 25 MHz 386
At Half the Price of Compaq or IBM

Omega 386/25 $3295 386/16 **$2985**

Complete High Quality 386/25/20/16 Systems

Omega 386/25/20/16 Motherboard
Hard/Floppy Controller 1:1 Interleave
I/O Card (Parallel, Serial, Game Ports)
Two 32 Bit, Four 16 Bit, & Two 8 Bit slots
Monochrome Graphics/Printer Adapter
1 Mb 80ns Memory (expandible up to 16 Mb)
* Ram Cache 386 soon available

Toshiba 40Mb 25ms Hard Drive
Teac 1.2Mb Floppy drive
101 Key Enhanced Keyboard
230 Watt Power Supply
AT Case Turbo/Leds, 5 Drive Slots
Packard Bell TTL Amber Monitor
* Tower Case available

All systems are custom assembled and burned in by OMI technical personnel and come with a 1 year warranty on parts & labor. All Prices Subject to Change without notice. IBM & Compaq are Trademarks of their respective Corporations.

Test Results

386/25	286/20
Norton SI Ver 4.0	
28.2	27.3
Landmark Ver .99	
33.6	26.7
Power Meter Ver 1.20	
4.25 Mips	3.64 Mips

The Fastest 286 Available
286/20/16/12 System Specs

Omega 286/20/16/12 Mother Board
Award BIOS
Hard/Floppy Controller 1:1 Interleave
I/O Card (Parallel, Serial, Game Ports)
Six 16 Bit Slots & Two 8 Bit Slots
1 Mb Memory Installed

Teac 1.2Mb Floppy Drive
101 Key Enhanced Keyboard
230 Watt Power Supply
AT Case Turbo/Leds, 5 Drive Slots
Monochrome Graphics/Printer Adapter
Packard Bell TTL Amber Monitor

286/20 $1895
286/16 $1795
286/12 $1495

Omega 88/10 XT Compatible

10MHz XT Motherboard (Phoenix BIOS)
Teac 360K Floppy Drive
Packard Bell TTL Amber Monitor
Floppy I/O Controller (2F,CLK,PP, SP, GP)
150 Watt Power Supply
AT Jr Case Turbo/Leds
Keytronics 101 Key Keyboard
Monochrome Graphics/Printer Adapter
8 Expansion Slots
640K Memory Installed **$795.00**

Printers

Panasonic	
1080I	$181
1091	$222
1092	$361
1592	$400
1595	$473

Modems

1200I	$57
1200E	$95
2400I	$103
2400E	$162

Hard Drives

Toshiba	
40Mb 25ms	$543
70Mb 25ms	$895
Micropolis	
72Mb 28ms	$610
Miniscribe	
8425 20Mb 65ms	$281
8438 20Mb 65ms	$287
3053 40Mb 25ms	$618
3085 72Mb 28ms	$720
6085 72Mb 28ms	$966
6128 100Mb 28ms	$850

Floppy Drives

Teac	
720k 3.5"	$115
1.44M 3.5"	$125
360k 5.25"	$89
1.2M 5.25"	$104

SMS Omti

5527 XT RLL	$83
8240 AT MFM	$144
510 SCSI	$65
512 SCSI	$80

Monitors

Samsung White Mono	$100
Packard Bell Mono	$80
Thomson Mono	$110
Princeton MAX12	$158
Thomson CGA	$240
Mitsubishi CGA	$269
Packard Bell EGA	$375
Samsung EGA	$386
Mitsubishi EGA	$408
Mitsubishi Multi	$528
Technica Multi	$443
Tatung VGA	$582

Other product lines offered:
Video Seven
Keytronics
Northgate
Archive
Novell
AutoDesk
Epson
Western Digital
DTC
Sharp
And Many More!

Call For More Information Including Complete Product Catalogue
OMEGA MICROSYSTEMS INC.
1029 Franklin Road Suite 4-C Marietta, Georgia 30067

Toll Free (800) 346-6527
In Georgia (404) 429-8862
Fax: (404) 953-6286

Hours: 9am-8pm EST
Monday thru Friday

We Will Gladly Answer Any Customer's Technical Questions!

Circle 158 on Reader Service Card

Introducing GTEK's® Family

$389

MODEL 7128
- Compatible with virtually any computer.
- High performance to cost ratio.
- Programs all popular chips, including MPUs.

$495

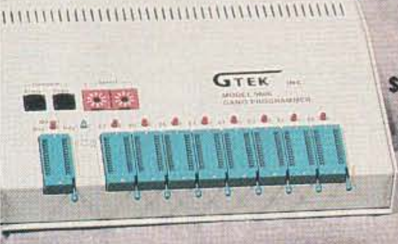
MODEL 7344 PAL DEVELOPMENT SYSTEM
- Includes programmer, GPC Compiler and communications software.
- Program, secure and functionality test 20 & 24 pin pals.
- Supports MMI, NAT, TI, Cypress Erasable PALS.
- A must for any new cost effective design.

$299

MODEL 705
- Stand alone operation.
- Programs Motorola 68705 Family MPUs.
- One button operation from cycle power to verify.
- Great for production.

MODEL 7228
- Programs all popular chips to 512K.
- Intelligent programming algorithms.
- High performance to cost ratio.

$499

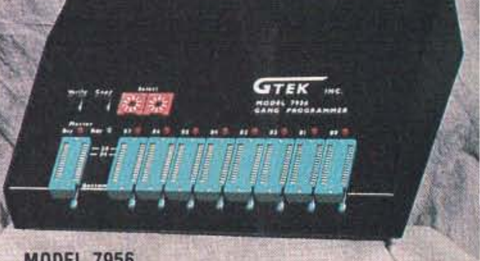


$1348

MODEL 9800
- Programs 8 parts at a time.
- Programs all chips, to one megabit, including single chip processors.
- Operates serial to 56Kbps or stand alone.
- Programs 2764 in 5 seconds.
- Ultra fast communications software.

$699

MODEL 9000
- Fastest programmer on the market.
- Quick & Intelligent programming algorithms.
- Programs all chips, to one megabit, including single chip processors.
- Programs largest variety of chips incl. Prom replacements, Eproms and EEProms.



$899

MODEL 7956
- Programs 8 eproms at a time.
- Programs chip to 512K, including single chip processors.
- Operates serial or stand alone.
- Switch selectable part selection.

MODEL ROMX-2XL EPROM EMULATOR

NEW!

$399

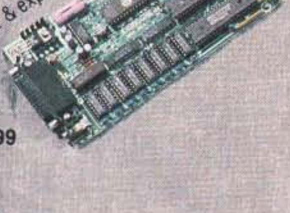
- Emulates 2716-27010 eproms.
- 256K to 1024K memory available.
- Battery backed up, auto emulate on power-up.
- Low-cost, pays for itself on first project.
- Free 19.2K Serial Communications Software.

PCSS-8I INTELLIGENT SERIAL BOARD
- 8 interrupt driven RX/TX channels/card.
- 1-8 cards per computer.
- BIOS Enhanced Software incl.
- Reduces host processor overhead.
- 32-128KByte buffer memory.
- May be used stand alone in custom appl.

NEW!

$695

ODEL 2010 SINGLE BOARD COMPUTER
- 2010B: Intel 8052AH - Basic V1.1 Solid State EEProm Disk System.
- 2010M: Machine Language with built-in assembler/disassembler.
- 64KByte RAM, 40 bit programmable I/O lines.
- RS232 & expansion interface.



$299

$495

PCSS-8X SERIAL BOARD
- Eight RS232 ports per card (optional 4 port).
- All eight ports 100% DOS compatible.
- 32 ports may be added to a PC.
- Optional RS422 to 4000 ft.
- Interrupt driven BIOS Enhancement Software included free.

All GTEK products are manufactured by GTEK in the U.S.A., are fully warranted for 1 year and offer free technical support.

Intel is a registered trademark of Intel Corp
MMI & PAL is a registered trademark of MMI Corp.
TI is a registered trademark of Texas Instruments Corp.
Cypress is a registered trademark of Cyoress Semiconductor
Motorola is a registered trademark of Motorola Corp
GTEK is a registered trademark of GTEK, Inc

Circle 99 on Reader Service Card

GTEK®, INC.

Development Hardware & Software
P. O. Box 2310
Bay St. Louis, MS 39521-2310
Order Toll Free 1-800-255-GTEK (4835)
Fax: 1-601-467-0935 Telex 315814 (GTEK UD)
MS & Technical Support 1-601-467-8048

comes complex when the line style, angle, and antialiasing (smoothing the stair-step appearance of angled lines) has to be taken into account.

To effectively support these additional capabilities, system designers developed custom chips and standard processors with extended instructions for fast graphics processing. The best-known of these is the current TI 34010, a general-purpose processor with special hardware support for graphics operations. (See "The TMS34010 Graphics System Processor" by Carrell R. Killebrew Jr., December 1986 BYTE.)

A number of companies took the alternate approach of custom graphics processors. Intel and Hitachi made single chips, while AMD and National Semiconductor developed multiple chip sets.

The single-chip designs of Intel and Hitachi are far apart in terms of concept and architecture. Hitachi built a device (7220) that can be used alone or in pairs, but it still depends on the host for most of the graphics work internally, while serving as an interface to the display device.

Intel put three cooperating processors on one chip, with external interfaces to the host memory, display memory, and the display device, with processing and access shared on a priority basis. (See "Inside the 82786 Graphics Chip," August 1987 BYTE.) One processor does graphics functions on the display memory (based on commands from the host), a second handles memory refresh, and a third converts the internal representation to an external pixel stream, including multiple window support. A fourth component handles the priority conflicts between host, internal processors, and memory, for both system and display.

Multichip designs offer a more flexible organization and typically higher performance than single-chip designs, at the cost of a more complex design process and more board space. AMD's Am95C60 and National Semiconductor's DP8500 family are among the multichip graphics processors. Both these multichip versions preceded the Intel and TI single-chip processors.

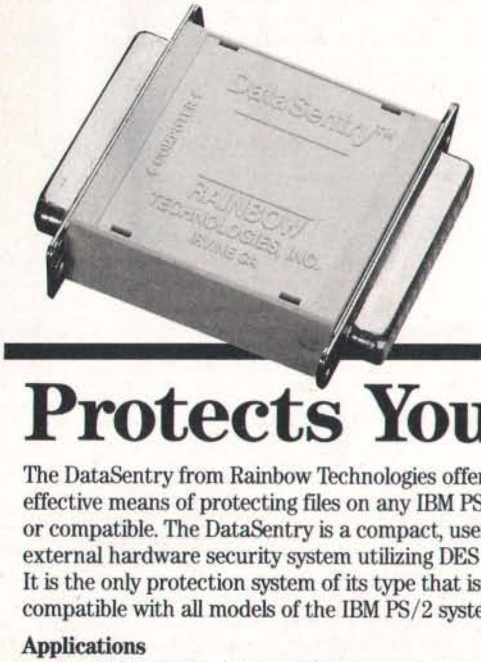
While no single chip is representative of the whole set, the AMD Am95C, known as the Quad Pixel Dataflow Manager, is representative of this class of processors. As a minimum, the QPDM requires commands from the host via direct memory access, a video memory of four planes per QPDM chip, and a color palette. The QPDM processor does perform the basic graphics functions independently of the host and runs at a 20-MHz clock rate, providing fast graphics performance with up to a 2048 by 2048 display device.

The QPDM refreshes the graphics memory and the video display, updates the graphics memory based on commands from the host, and supports a single hardware window. Its basic commands include drawing lines, arcs, and circles, all including optional antialiasing, block move, filled rectangles, and string moves for fast character displays.

Today and Tomorrow

The current standard display controllers are "dumb"; that is, they depend on the host to calculate and write every pixel on the screen. Some current VGA controllers support 800 by 600 with 16 or 256 colors, and even fast systems will spend an excessive amount of time updating

continued



Data Sentry™

Protects Your PS/2 and PC Data

The DataSentry from Rainbow Technologies offers a cost-effective means of protecting files on any IBM PS/2, PC/XT/AT, or compatible. The DataSentry is a compact, user-installable, external hardware security system utilizing DES methodology. It is the only protection system of its type that is fully compatible with all models of the IBM PS/2 system.

Applications
- IBM PC/XT/AT and compatibles
- IBM PS/2 — *all models*
- Laptop computers

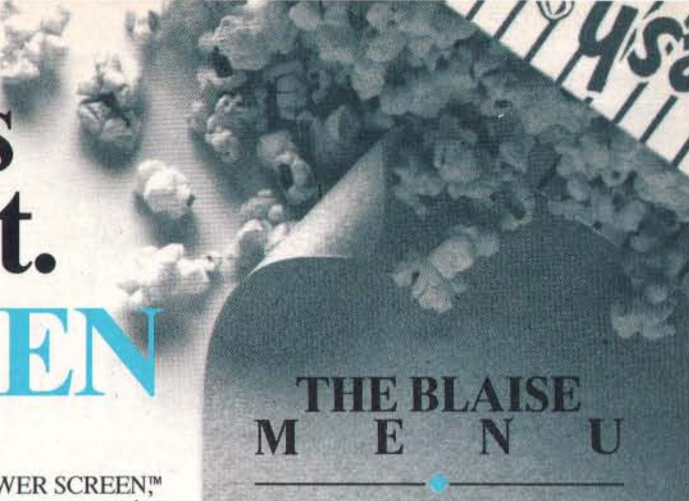
Benefits
- Secured modem transmissions
- File privacy on shared computers
- Department-wide data security

Features
- Simple to use and completely user-installable
- Can protect individual files or whole directories
- Encrypts files using DES or a fast proprietary algorithm
- Compresses encrypted files to save disk space
- Provides master keys for multi-level security systems
- Optional password protection

The DataSentry System. The Key to Safe Files.

RAINBOW TECHNOLOGIES
18011-A MITCHELL SOUTH IRVINE, CA 92714 USA
(714) 261-0228 TELEX: 386078 FAX: (714) 261-0260

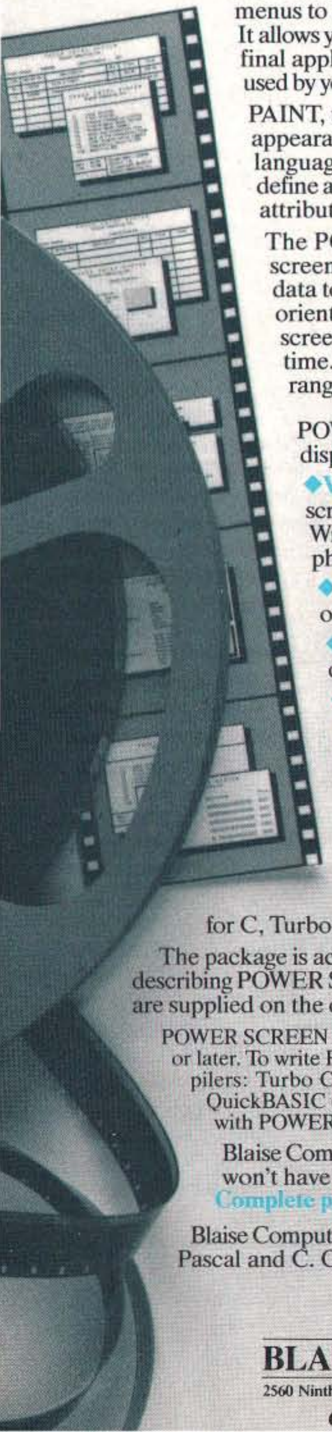
© 1988 Rainbow Technologies, Inc. DataSentry is a trademark of Rainbow Technologies. IBM is a registered trademark of International Business Machines.



Blaise Passes the Screen Test.

POWER SCREEN

Best performance in a supporting role.
Because your time is more valuable then ever, Blaise Computing presents POWER SCREEN,™ the new high performance screen management system designed to support your own creative programming efforts.



POWER SCREEN provides reliable, lightning fast data entry screens and menus to create your own sophisticated window oriented applications. It allows you to design screens exactly as you want them to appear in your final application. Screens are efficiently stored in a file so they can be used by your application or later modified without program code changes.

PAINT, the screen painter included with POWER SCREEN, has the appearance and performance of the popular integrated programming language environments. It lets you design and modify screens, and define and format fields. All VGA, EGA and monochrome text modes, attributes and colors are supported.

The POWER SCREEN Runtime Library allows you to construct screens in memory, display screens in windows and read and write data to fields within the screen. All screens and menus are window-oriented, so they can be stacked, removed or moved on the physical screen. You can access screens field-by-field or a whole screen at a time. POWER SCREEN takes care of field input editing, data and range checking, and data formatting.

POWER SCREEN out-performs the runners-up with a dazzling display of capabilities FEATURING:

- ◆ **Virtual screens.** Screens that can be larger than the physical screen, with just a portion of the screen displayed within a window. Write to any screen any time, even if it is not visible. Automatic physical screen update.
- ◆ **Context sensitive help.** Create help text on a field-by-field basis or for the entire screen with a window-oriented help facility.
- ◆ **Intervention routines.** Install them so your application gains control when a field is entered, exited and between keystrokes.
- ◆ **Range checking.** Supported for all standard data types.
- ◆ **Unlimited screens.** Subject only to the amount of available memory.
- ◆ **Definable keys.** Fully configurable field editing keys.

POWER SCREEN includes PAINT, the POWER SCREEN Runtime Library, as well as other utilities for creating help files and maintaining and documenting your screen database files. Language interfaces with source code are included for C, Turbo Pascal 4.0 and QuickBASIC.

The package is accompanied by a fully-indexed comprehensive User Reference describing POWER SCREEN procedures and utilities. Complete example programs are supplied on the diskettes.

POWER SCREEN requires an IBM PC, XT, AT, PS/2 or close compatible and DOS 2.00 or later. To write POWER SCREEN applications, you need one of the supported compilers: Turbo C, Microsoft C (4.00 or later), QuickC, Turbo Pascal (4.0 or later), QuickBASIC (4.0 or later). Interfaces for all supported compilers are included with POWER SCREEN.

Blaise Computing: We've passed the screen test so you won't have to.
Complete price: $129.

Blaise Computing has a full line of support products for both Pascal and C. Call today for your free information packet.

BLAISE COMPUTING INC.
2560 Ninth Street, Suite 316 Berkeley, CA 94710 (415) 540-5441

Circle 28 on Reader Service Card

THE BLAISE MENU

Turbo POWER TOOLS PLUS *$129.00*
Screen, window, and menu management including EGA and VGA support; DOS memory control; ISRs; scheduled intervention code; and much more. For Turbo Pascal.

Turbo ASYNCH PLUS *$129.00*
Interrupt driven support for up to four COM ports. I/O buffers up to 64K; XON/XOFF; hardware handshaking; up to 19.2K baud; modem control and XMODEM file transfer. For Turbo Pascal.

C TOOLS PLUS *$129.00*
Windows; menus; ISRs; intervention code; screen handling and EGA 43-line text mode support; direct screen access; DOS file handling and more. Specifically designed for Microsoft C 5.0 and QuickC.

C ASYNCH MANAGER *$175.00*
Full featured interrupt driven support for up to four COM ports. I/O buffers up to 64K; XON/XOFF; hardware handshaking; up to 19.2K baud; modem control and XMODEM file transfer; For Microsoft C and Turbo C.

Turbo C TOOLS *$129.00*
Full spectrum of general service utility functions including: windows; menus; memory resident applications; interrupt service routines; intervention code; and direct video access for fast screen handling. For Turbo C.

KeyPilot *$49.95*
"Super-batch" program. Create batch files which can invoke programs and provide input to them; run any program unattended; create demonstration programs; analyze keyboard usage.

EXEC *$95.00*
Program chaining executive. Chain one program from another in different languages; specify common data areas; less than 2K of overhead.

RUNOFF *$49.95*
Text formatter for all programmers. Written in Turbo Pascal: flexible printer control; user-defined variables; index generation; and a general macro facility.

TO ORDER CALL TOLL FREE
800-333-8087

NOW

THE SEARCH IS OVER! Peter Norton's Online Guides Instant Access Program eliminates most manual searches with a few simple keystrokes. Now, when you order our featured product, we'll send you it's Online Database along with Peter Norton's Instant Access Program, absolutely free!

Microsoft C, QuickC and QuickBASIC are registered trademarks of Microsoft Corporation. Turbo C and Turbo Pascal are registered trademarks of Borland International.

that large a graphics display. Even with the performance of an 80386, we've just about reached the limit of this approach to support fast graphics. New applications will demand more of the host processor, leaving fewer cycles to drive the display without visible slowdown. All evidence points to the technology having reached a transition point.

What comes next should be obvious—display controllers driven by their own graphics processor. IBM has revealed in advance that its next display controller will have a graphics processor built in. The 8514/A controller for the PS/2s already has some processing built in, but its capability is limited. The interface is totally software defined, and hardware specifications are not even available. This prevents software vendors from bypassing the software interface in search of short-term gains at the expense of long-term compatibility.

As we enter the era of GP-driven controllers with megabytes of display memory, the old technique of driving the hardware directly is obsolete and counterproductive. New displays will require processing well beyond what current systems have available. By 1990, most, if not all, display controllers will have a graphics processor or two to provide capabilities we can only dream of today. We can expect these future controllers to have multiple windows, three-dimensional displays, rotating displays, hidden-line removal, and shading of objects.

In all this discussion about graphics processors, let's not forget about the final key in the display chain: the display monitor itself. While the pace of monitor improvement does not match that of the semiconductor industry, displays have come a long way. The $700 CGA display of 1984 has given way to the $600 EGA display of 1986, which has given way to the $500 VGA display of 1988. This trend should continue as GPs and new software provide the push for even higher-resolution displays, at mass market prices. Today's $2000 1280 by 1024 color display will be 1989's $1500 display and 1990's $1000 display, with even better displays entering at the $2000 level.

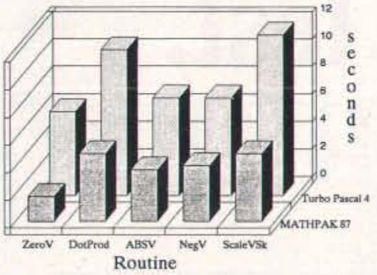
The acceptance of the graphics processor as a standard component of computer systems will change the way we view and use these systems in the years that lie ahead. ■

Bill Nicholls is an author and computer consultant with BGW Systems, Inc., in Puyallup, Washington. He can be reached as "billn" on BIX.

Circle 174 on Reader Service Card

MATHPAK 87 *High Performance 80x87 Software*

MATHPAK 87 is a set of over 130 assembler coded numerical routines for use with 80x87 math coprocessors. These routines are highly optimized and run up to 10 times faster than equivalent high-level language routines. A detailed and easy-to-read manual (180 pages) gets you started using *MATHPAK 87* in minutes. *MATHPAK 87* routines are *fast, convenient* and *reliable.*



MATHPAK 87 Timings (IBM XT)

Execution Times for 100,000 Operations

***MATHPAK 87* includes**: 65 vector/scalar routines (vector add, subtract, ...); 24 complex vector/scalar routines; 11 matrix routines (add, subtract, multiply, transpose, etc.); LU decomposition/backsolving routines for real and complex systems; Gaussian elimination; matrix inversion; tridiagonal equation solver routines; EISPACK eigenvalue/vector routines; statistical routines; FFT routines (1-D, 2-D, complex, real, convolution); spectral analysis routines (windows: Parzen, Hamming, ...); routines for numerical integration and solution of differential equations; and missing functions for Modula-2 and Pascal: tan, log10, alog10, power, sinh, cosh and tanh.

MATHPAK 87 routines are the fastest available! On an IBM XT, a 1K complex FFT takes 1.85s (real 1.0s); dot product (length 10,000) takes 0.494s.

$99 US for Turbo Pascal 4.0 version. $119 US for MS Fortran, IBM Pro Fortran, Lahey F77L, MS C, Lattice C, Logitech Modula-2 or ITC Modula-2 versions. *Please specify version*. Add $5 shipping/handling.

Precision Plus Software, 1239 Sir David Drive, Oakville, Ontario, Canada L6J 6Y9. Telephone: (416) 829-1511, FAX: (416) 829-1742.

International Dealers: U.K.: Grey Matter Ltd., Tel: (0364) 53499; West Germany: SOS Software Service GmbH, Alter Postweg 101, 8900 Augsburg, Tel: 0821/57 1081.

AMX 86

KADAK's engineers bring years of practical real-time experience to this mature

MULTI-TASKING SYSTEM

(version 2.0)

for the IBM® PC, PC/XT and PC/AT

- No royalties
- IBM PC DOS® support
- C language support
- Preemptive scheduler
- Time slicing available
- Source code of the C interface and device drivers is included
- Intertask message passing
- Dynamic operations:
  - task create/delete
  - task priorities
  - memory allocation
- Event Manager
- Semaphore Manager

AMX86™ operates on any 8086/88, 80186/88, 80286 system.

Demo package	**$25 US**
Manual only	**$75 US**
AMX86 system	**$2195 US**

(shipping/handling extra)

Also available for 8080, Z80, 68000

KADAK Products Ltd.
206–1847 W. Broadway
Vancouver, B.C., Canada
V6J 1Y5
Telephone: (604) 734-2796
Telex: 04-55670

Circle 120 on Reader Service Card

Tandy® Computers: The broadest line of PCs in America.

The Tandy 4000 LX

Get the power and performance of Intel's 80386 ...at 20 MHz.

To complete business tasks on schedule, turn to the Tandy 4000 LX. With its 32-bit Intel® 80386 microprocessor operating at 20 MHz, the 4000 LX delivers a new level of performance to sophisticated database management and spreadsheet analysis.

Two megabytes of zero wait-state memory make the 4000 LX ready to use with MS® OS/2, as well as MS-DOS® software. With this much memory standard, the Tandy 4000 LX is also ready to use as the hub of a powerful multiuser office system running SCO® XENIX® software. And as a network file server in a 3Com® workgroup, the 4000 LX provides 20 MHz performance for exceptionally high-speed data transfer.

The Tandy 4000 LX is highly expandable. Three front-panel device slots and eight expansion slots give power users the flexibility needed in configuring the optimum system.

And for entry-level 386™ power, we offer the original Tandy 4000. Using an 80386 processor that operates at 16 MHz, the 1MB Tandy 4000 is the perfect low-cost choice for the heavy power user.

The new generation Tandy 4000 LX. From the best-selling family of PC compatibles made in America.

Send me a 1989 RSC-20 computer catalog.

Mail to: Radio Shack, Dept. 89-A-103
300 One Tandy Center, Fort Worth, TX 76102

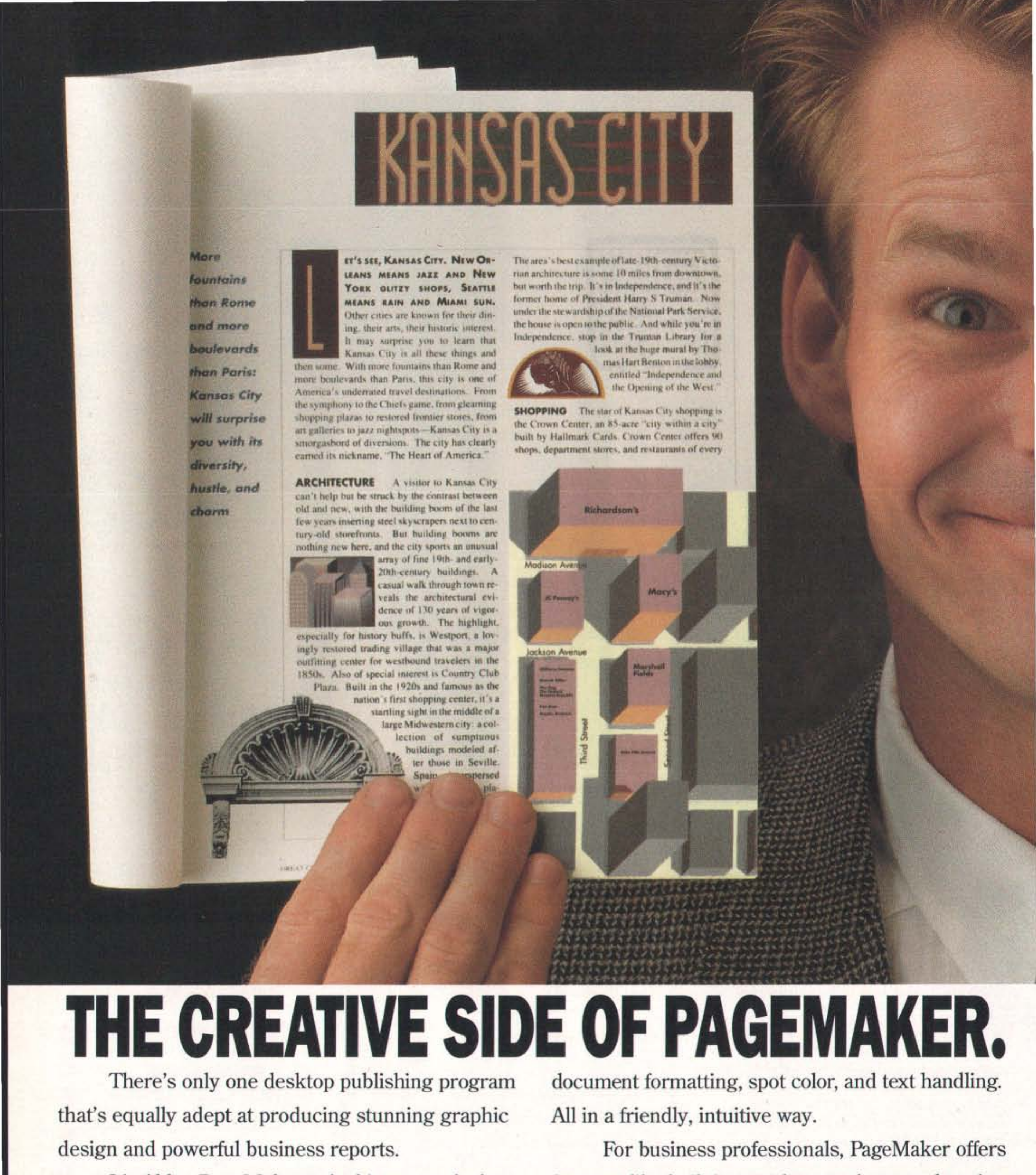
Name ____________________
Company ____________________
Address ____________________
City ____________ State ______
ZIP ____________ Phone ____________

Tandy Computers: Because there is no better value™.

Radio Shack®
COMPUTER CENTERS
A DIVISION OF TANDY CORPORATION

Intel/Reg. TM and 386/TM Intel Corp. MS, MS-DOS and XENIX/Reg. TM Microsoft Corp. SCO/Reg. TM The Santa Cruz Operation. 3Com/Reg. TM 3Com Corp.

Circle 185 on Reader Service Card



KANSAS CITY

More fountains than Rome and more boulevards than Paris: Kansas City will surprise you with its diversity, hustle, and charm

LET'S SEE, KANSAS CITY. NEW ORLEANS MEANS JAZZ AND NEW YORK GLITZY SHOPS, SEATTLE MEANS RAIN AND MIAMI SUN. Other cities are known for their dining, their arts, their historic interest. It may surprise you to learn that Kansas City is all these things and then some. With more fountains than Rome and more boulevards than Paris, this city is one of America's underrated travel destinations. From the symphony to the Chiefs game, from gleaming shopping plazas to restored frontier stores, from art galleries to jazz nightspots—Kansas City is a smorgasbord of diversions. The city has clearly earned its nickname, "The Heart of America."

ARCHITECTURE A visitor to Kansas City can't help but be struck by the contrast between old and new, with the building boom of the last few years inserting steel skyscrapers next to century-old storefronts. But building booms are nothing new here, and the city sports an unusual array of fine 19th- and early-20th-century buildings. A casual walk through town reveals the architectural evidence of 130 years of vigorous growth. The highlight, especially for history buffs, is Westport, a lovingly restored trading village that was a major outfitting center for westbound travelers in the 1850s. Also of special interest is Country Club Plaza. Built in the 1920s and famous as the nation's first shopping center, it's a startling sight in the middle of a large Midwestern city: a collection of sumptuous buildings modeled after those in Seville, Spain [illegible] interspersed w[illegible] pla-

The area's best example of late-19th-century Victorian architecture is some 10 miles from downtown, but worth the trip. It's in Independence, and it's the former home of President Harry S Truman. Now under the stewardship of the National Park Service, the house is open to the public. And while you're in Independence, stop in the Truman Library for a look at the huge mural by Thomas Hart Benton in the lobby, entitled "Independence and the Opening of the West."

SHOPPING The star of Kansas City shopping is the Crown Center, an 85-acre "city within a city" built by Hallmark Cards. Crown Center offers 90 shops, department stores, and restaurants of every

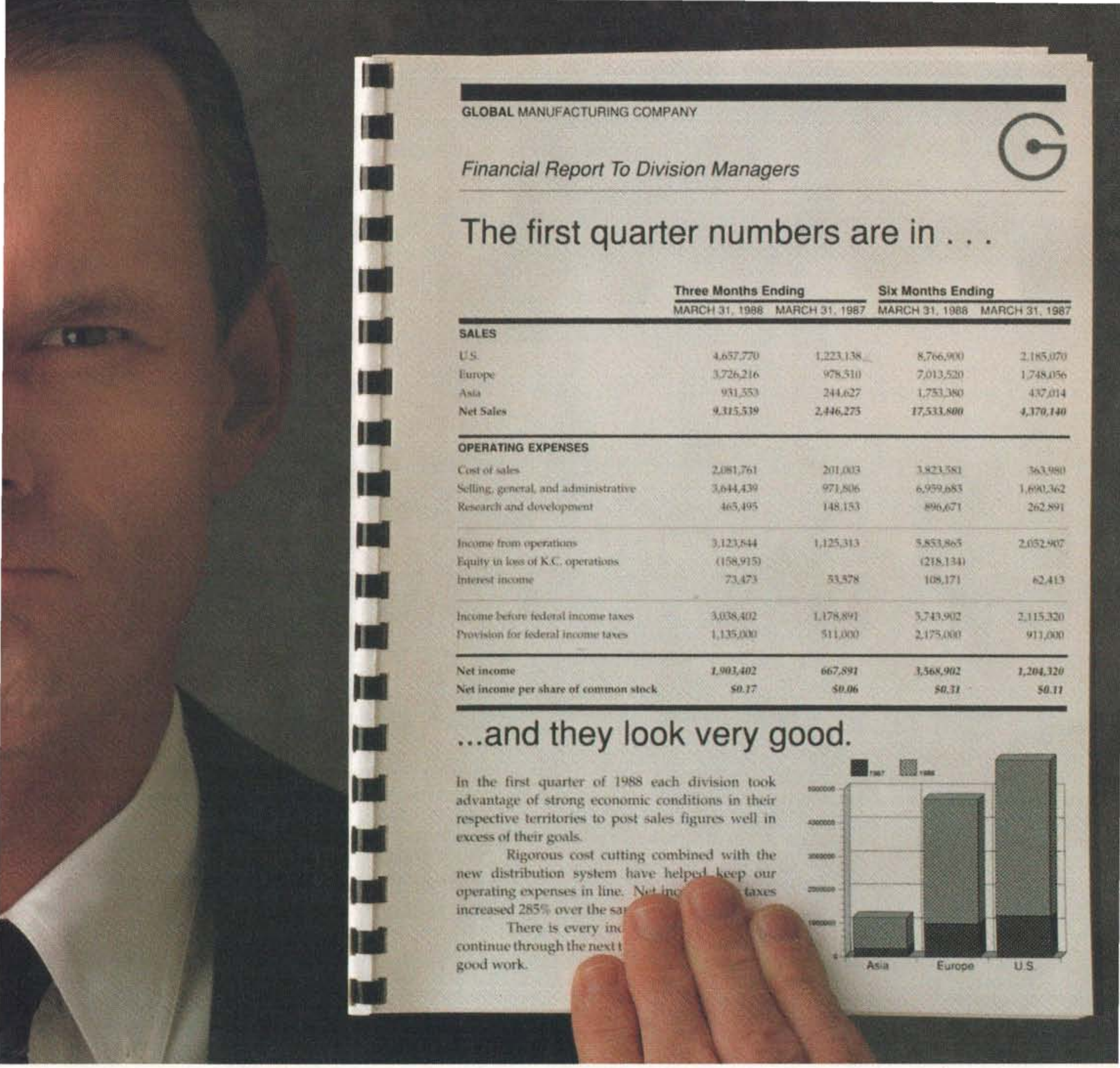
THE CREATIVE SIDE OF PAGEMAKER.

There's only one desktop publishing program that's equally adept at producing stunning graphic design and powerful business reports.

It's Aldus PageMaker.® And it means desktop publishing to more people around the world than any other program.

For creative professionals, PageMaker offers powerful features for precise page composition, document formatting, spot color, and text handling. All in a friendly, intuitive way.

For business professionals, PageMaker offers features like built-in templates and comprehensive support for long documents. It's the first desktop publishing program to run on both Macintosh® and PC computers. And it's compatible with more business software and peripherals than any other



GLOBAL MANUFACTURING COMPANY

Financial Report To Division Managers

The first quarter numbers are in . . .

	Three Months Ending		Six Months Ending	
	MARCH 31, 1988	MARCH 31, 1987	MARCH 31, 1988	MARCH 31, 1987
SALES				
U.S.	4,657,770	1,223,138	8,766,900	2,185,070
Europe	3,726,216	978,510	7,013,520	1,748,056
Asia	931,553	244,627	1,753,380	437,014
Net Sales	***9,315,539***	***2,446,275***	***17,533,800***	***4,370,140***
OPERATING EXPENSES				
Cost of sales	2,081,761	201,003	3,823,581	363,980
Selling, general, and administrative	3,644,439	971,806	6,959,683	1,690,362
Research and development	465,495	148,153	896,671	262,891
Income from operations	3,123,844	1,125,313	5,853,865	2,052,907
Equity in loss of K.C. operations	(158,915)		(218,134)	
Interest income	73,473	53,578	108,171	62,413
Income before federal income taxes	3,038,402	1,178,891	5,743,902	2,115,320
Provision for federal income taxes	1,135,000	511,000	2,175,000	911,000
Net income	***1,903,402***	***667,891***	***3,568,902***	***1,204,320***
Net income per share of common stock	***$0.17***	***$0.06***	***$0.31***	***$0.11***

...and they look very good.

In the first quarter of 1988 each division took advantage of strong economic conditions in their respective territories to post sales figures well in excess of their goals.

Rigorous cost cutting combined with the new distribution system have helped keep our operating expenses in line. Net inc taxes increased 285% over the sa

There is every inc continue through the next t good work.

THE BUSINESS SIDE OF PAGEMAKER.

desktop publishing program available today.

Which explains why over 200,000 creative and business professionals around the world have chosen Aldus PageMaker.

To get a closer look at the creative and business sides of PageMaker, visit your authorized Aldus dealer, or call 1-800-33-ALDUS to order a $4.95 self-running demo disk. Or you can order a colorful videotape demonstration for just $9.95. In Washington state call (206) 628-2375.*

ALDUS *Aldus PageMaker*®

411 First Avenue South, Seattle, WA 98104 (206) 622-5500.

*Offer good in U.S. and Canada only. The PC demo disk requires an IBM PS/2, PC AT, or compatible with EGA or VGA card and color monitor. The Macintosh demo disk requires an Apple Macintosh 512K Enhanced, Plus, SE, or II; at least 1 MB RAM; Apple System file 4.1 or higher; Finder 5.5 or higher.

Aldus, the Aldus logo, and PageMaker are registered trademarks of Aldus Corporation. Apple and Macintosh are registered trademarks and Finder is a trademark of Apple Computer Inc. IBM is a registered trademark and PS/2 is a trademark of International Business Machines Corporation. ©1988 Aldus Corporation. All rights reserved.

Circle 4 on Reader Service Card (DEALERS: 5)

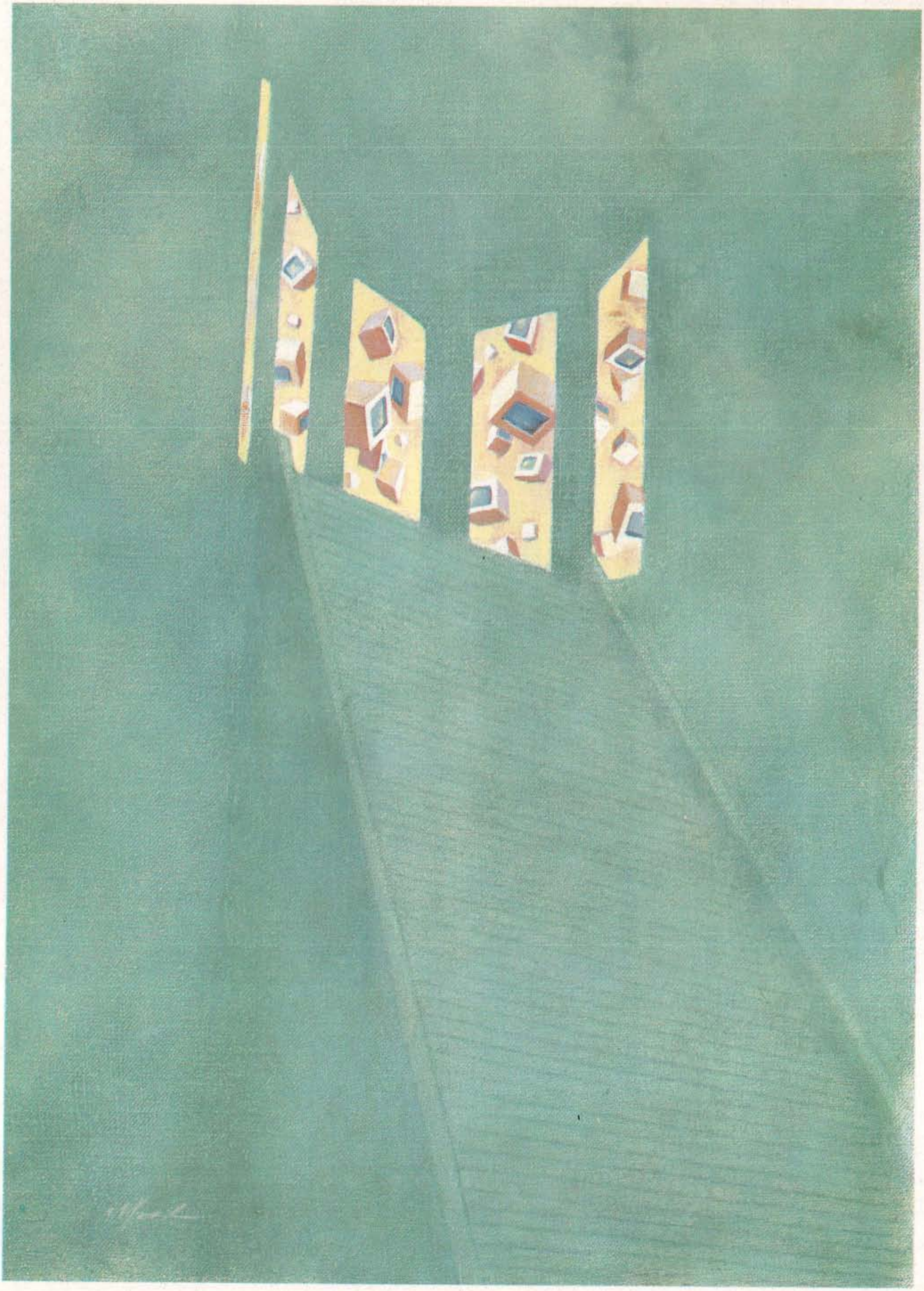


ILLUSTRATION: PAUL MOCK © 1988

LIFE AFTER DOS

Outgrown MS-DOS? Here are six programs that bring multitasking features to 80386 computers without resorting to OS/2

Namir Clement Shammas

In April 1987, IBM announced a new operating system, OS/2. Microsoft and IBM had collaborated in developing this new operating system, which caters to the 80286. The 80286 chip is found in the many IBM PC ATs and compatibles. OS/2 introduced new features, such as multitasking, task scheduling, and piping between different processes, just to name a few.

To the end user, OS/2 exhibits rather limited multitasking support for applications written for standard MS-DOS. This feature is attributable to the architecture of the 80286 chip. The limitations have been overcome by the more powerful 80386 and its virtual real mode, which is not available in the 80286. In real mode, one operating system and one program run at a time. Using the virtual real mode, the 80386 is able to execute multiple 8086 programs as though each were running on a separate machine.

In addition, the 80386 chip has virtual memory management and memory paging, and it handles memory segments that are larger than the 64K bytes of the 80286. These 80386 features let programmers create environments that support multitasking DOS applications, implement virtual 8086 machines, and break the 640K-byte memory barrier (by using extended memory to simulate expanded memory for memory paging). (Also see "High-Speed Memory Boards for ATs" by Barry Nance in the December 1987 BYTE and "It's a Natural" by Bud E. Smith in the July BYTE.)

The 80386-based concurrent-DOS environments bring multitasking and the use of all available memory into play. Now that these capabilities are actually at hand, programmers and end users must ask themselves how to put them to work. Two general ways to use such environments are as follows:

- Using the multitasking environment to quickly and frequently switch two or more applications. The emphasis is more on the ability to navigate among various applications or multiple instances of the same application. Performing background work is at a minimum or not used at all. If your interest is mainly in this type of application management, then 80386 environments are by no means the unique providers for such requirements.
- Using the multitasking environment to focus on one main application that requires rather extensive human interaction while running other programs in the background. Programs that function in the background must be able to run unattended for at least the duration of certain tasks. In this category, you have, for example, bulletin boards; print spoolers; archiving utilities; large spreadsheet recalculations; extensive and time-consuming number-crunching engineering, scientific, and statistical programs; and extensive database sorting or indexing.

Bulletin boards represent a special class of background tasks that suddenly need the attention of the CPU. Most 80386-based environments have catered to that need.

Personality Profiles

In this article, I will look at six 80386-based environments that support concurrent DOS. They include Windows/386 from Microsoft; VM/386 from IGC; DESQview 2.01 from Quarterdeck Office Systems; Omniview from Sunny Hill Software; Concurrent DOS 386 from Digital Research; and PC-MOS from The Software Link. Keep in mind that each package was designed to express a product personality reflecting the philosophy and intent of its developers.

Windows/386 is a graphics-based environment complete with pull-down menus, windows, and icons. Its interface is very similar to that of the OS/2 Presentation Manager, and it also provides file management facilities for single users.

VM/386 is a text-based environment for multiple virtual 8086-based PCs. The VM/386 emphasis is on defining virtual machines and spawning them as either background or foreground tasks. Any of the virtual machines can crash, and you can reboot them without affecting the others. VM/386 can run on IBM's Token Ring Network.

DESQview 2.01 has evolved from earlier versions that were designed to run

continued

with the 8086 and 80286 chips. Version 2.01, tailored toward the 80386, delivers a combination of text-based windows able to display different tasks, a family of well-designed pop-up menus, and multitasking capabilities. DESQview also runs on networks.

Omniview is an interesting product that really stands out for its flexible and modest hardware and software requirements, and it gives you the multitasking capability you seek. This program works with most networks.

Concurrent DOS 386 is an environment that attempts to bring an 80386 version of CP/M-86 to PC-DOS. Conceived by the company that developed the Z80-based CP/M, this product comes across like a cat with nine lives. From my comparison of this package with the other environments, I believe that Digital Research did not develop the package from the ground up. Instead, the company relied on upgrading previous versions. As a result, the product has design limitations inherited from previous (non-80386) versions. Concurrent DOS 386 does offer a superset of DOS commands, multitasking, and multiuser support with some practical limitations.

The PC-MOS environment is very different from the rest of the lot. It is an operating system that can be seen as a superset of PC-DOS implemented for the 80386 machines. It provides its own system file, its own command processor, internal and external MOS commands, a task manager, a text editor, a debugger, and multiuser support. PC-MOS employs many commands that are available in standard DOS and adds a few good new ones. Table 1 shows the system requirements of the six packages.

Table 1: *System requirements for the six packages. Note that DESQview and Omniview can operate with two 360K-byte floppy disk drives or one 360K-byte floppy disk drive and one hard disk drive.*

	Windows/386	**VM/386**	**DESQview**
Version run	2.1	1.1	2.01
DOS version	3.1, 3.2, or 3.3	3.0 or higher	2.0 to 3.3
Drives	1.2-megabyte floppy disk and a hard disk (2-megabyte space)	1.2-megabyte floppy disk and a hard disk (2-megabyte space)	Two 360K-byte floppy disks or one 360K-byte floppy disk and one hard disk
RAM (megabytes)			
Minimum	1	2	0.64
Recommend	2	2+	Not specified
Video	CGA, EGA, VGA	MDA, Hercules, CGA, EGA, VGA	(Optional) CGA, Hercules, EGA
Modem	Optional	No	(Optional) Hayes or compatible
Can run with			
80286	No	No	Yes
8086/88	No	No	Yes

Setting Up the Environments

How hard is it to install these multitasking DOS environments? And once you've got them installed, how hard is it to alternate between sessions that use the standard DOS and the concurrent environment?

To set up Windows/386, you use the SETUP.EXE program located on the distribution disks. The steps involve selecting the type of computer, display adapter, keyboard, and country. The setup process is very smooth. However, you may need to alter your CONFIG.SYS file so that it doesn't install RAM disks, and change the AUTOEXEC.BAT to avoid loading RAM-resident programs. You may elect to create a special boot disk with the customized versions of the AUTOEXEC.BAT and CONFIG.SYS files. With this process, you can run Windows/386 only when you need it; otherwise, you use standard DOS.

Installing the VM/386 environment is straightforward. First, you make copies of your current AUTOEXEC.BAT and CONFIG.SYS files because the system setup utility modifies them. Then you need to remove all RAM-resident utilities installed by the AUTOEXEC.BAT. The SETUP.EXE utility queries you about the compatibility level of your system. You may create a special boot disk to run VM/386 at your discretion and alternate with standard DOS.

The DESQview environment is very simple to install on a hard disk drive, a high-density floppy disk drive, or two 360K-byte floppy disk drives. While DESQview also runs under the 8088, 8086, and 80286, only the 80386 version offers concurrency utilizing a single CPU.

Installing DESQview for the 80386 involves two steps: You install DESQview itself, and then you install Quarterdecks's Expanded Memory Manager 386. The QEMM-386 is a driver that permits the use of extended memory in a manner similar to expanded memory (compatible with Expanded Memory Specifications [EMS] 3.2 and 4.0). Once installed, the QEMM-386 permits DESQview to swiftly swap concurrently running tasks between the extended memory and the first 640K bytes of RAM space. I was able to install DESQview on a high-density floppy disk drive after modifying my CONFIG.SYS and AUTOEXEC.BAT files.

When setting up Omniview, you will see that the program has incredibly modest requirements that don't compromise its very flexible nature. In other words, Omniview is a very resourceful package. The environment can be installed on either floppy or hard disks. It is worth pointing out that the CONFIG.SYS and AUTOEXEC.BAT need not be changed. In fact, I first installed Omniview on a 360K-byte floppy disk and was able to run it from the floppy disk. A better arrangement, though, was to copy the files of the installed disk to my RAM disk and run Omniview from there, after setting the swap DOS-environment variable to the RAM disk.

Omniview is able to take advantage of extended memory, expanded memory, enhanced expanded memory, RAM disk space, or hard disk space to overcome DOS's 640K-byte limitations. In order to use the extended memory, you must use separate drivers. Regarding expanded memory, Omniview supports the drivers for EMS 3.2 and 4.0.

You install Concurrent DOS 386 by booting from the first distribution disk. A setup program creates two new directories on the hard disk and modifies the AUTOEXEC.BAT. You will most likely

Omniview	Concurrent DOS 386	PC-MOS
4.0	2.0	2.1
2.0 to 3.4	3.0 to 3.3	Installs MOS over MS-/PC-DOS
Two 360K-byte floppy disks or one 360K-byte floppy disk and one hard disk	One floppy disk (for setup), plus one hard disk for operation	One floppy disk (for setup), plus one hard disk for operation
0.256 Expanded memory	0.512 Expanded memory	1 1+
MDA, CGA, EGA, VGA	CGA, EGA, VGA	MDA, CGA, EGA
No	No	No
No No	No No	No No

need to further modify your AUTOEXEC.BAT, copy your CONFIG.SYS file as CCONFIG.SYS, rename CONFIG.SYS, and edit the device drivers in CCONFIG.SYS. When you reboot, the AUTOEXEC.BAT prompts you to decide whether or not to run Concurrent DOS 386. This is a welcome choice not found in the other packages. While memory requirement is modest, Concurrent DOS 386 does not make any provisions to utilize extended memory—only expanded memory.

Setting up PC-MOS is slightly more elaborate than setting up the other environments because this program sets up its own operating system. As a result, the setup process involves new system files, a new CONFIG.SYS file, and a new AUTOEXEC.BAT file.

To avoid alienating the user, PC-MOS supports several of the declarations familiar to PC-DOS CONFIG.SYS files, such as `DEVICE`, `BUFFERS`, `COUNTRY`, and `SHELL`. Other declarations enable you to reassign the default time-slice period; declare the size of a PC-MOS's RAM disk, the amount of disk cache, and EMS memory size; and allocate the various types of memory parameters.

You should only install PC-MOS on your hard disk if you intend to become a dedicated PC-MOS user. Alternating between DOS and PC-MOS requires not only restoring your original AUTOEXEC.BAT and CONFIG.SYS files, but also removing the PC-MOS system files and making sure that your DOS system files are present. Handling system files, with hidden attributes, requires the use of special utilities.

User Interfaces

Windows/386 is a graphics-based interface that fosters the use of the mouse, although you can also use the keyboard. The MS-DOS Executive window appears when Windows/386 begins to run. An application can possess one of three display levels: entire screen, window, or icon. Windows/386 can display standard DOS applications in any of these three display levels.

The MS-DOS Executive window is the launching point for many applications. It displays the names of the files and subdirectories of the current directory. Subdirectory names are displayed first using bold characters, while the list of sorted filenames is shown using normal characters. The current file or subdirectory selection appears in reverse video.

Since you do not have access to a command-line processor, everything is performed using pull-down menus. The MS-DOS Executive window has three menu options: file, view, and special. With the file menu, you can perform many internal DOS commands, such as `rename`, `copy`, and `delete` files, as well as load and run programs. These options work only on the highlighted file.

You can use MS-DOS Executive to mark multiple files for collective copying or deletion. With the file option, you can run an application and its related data file by simply loading the data file. For example, if you load a data file created by a database written for Windows/386, you produce a special icon. Clicking on that icon invokes the database and loads the accompanying data file.

The View menu enables you to view files in either short format (i.e., only the filename), or long format (which includes file size and date/time stamps). You can also elect to display all or some of the files, or just programs. You can use MS-DOS Executive to display the filenames sorted by name, date, size, or time. The Special option offers more important commands that you don't use as often. With these options, you can create a directory, change the current directory, format a disk, create a system disk, and set the disk volume name.

When an application is in either full screen or windows, the upper screen line displays the control-menu box, a title bar, and the maximize/minimize boxes. Via the latter boxes, you can alternate between a full-screen, a window, and an icon display. Windows/386 applications utilize the second line to display their menu bars. You can access the boxes in the top line or the menu options in the second line by using either a mouse or key combinations.

You can use the control box of any application to manipulate the related window in the following ways: move, resize, manipulate the display status (i.e., maximize or minimize), close, or restore. At that point, you can tell which options aren't available to you, because they are displayed in blurred characters or faded colors. You can use the `close` command to end the window applications. With standard applications, you need to exit using their own particular commands first, and then close their windows.

VM/386 basically offers a transparent control center that manages multiple virtual 8086-based PCs. VM/386 employs menus enclosed in text-based windows. For the DOS-related management of programs and files with VM/386, you load a copy of DOS and perform the required chores. Once you have defined your virtual machines, the VM/386 user interface becomes more or less transparent.

Each application occupies the entire screen, and you can't split the screen between two tasks. Pressing the Alt-Sys-

continued

Req keys pops up VM/386's main menu, so you have the option of invoking the VM/386 Manager or selecting any other loaded task.

The DESQview user interface employs a series of text-based pop-up menus. You can select from the menu using the cursor-control keys, typing in the hot keys (which appear only when the option is available), or using a mouse (which enhances the speed of menu selection). DESQview's main menu is invoked by simply pressing the Alt key. The DESQview menus are characterized by being short; some option categories are broken into two menus to avoid long menus.

It is interesting to note that DESQview does not employ one-line pull-down menus like those found in Windows/386. The main DESQview menu offers options that fall into four categories: task management, window management, data transfer, and help/exit options.

With the task management options, you can open a new window to run a new task, switch between tasks, and close a window removing its inactive task. Via the task management submenu, you can run a copy of DOS, invoke the DOS services, or spawn a task from the task list. Other task management options enable you to add, change, and delete tasks from the task list.

Using the window management options, you can rearrange a window's size, position, color, and visibility, and zoom in on a task, making it occupy the entire screen. DESQview does not hide (or temporarily suppress) the screen output of a background task that runs as a full-screen application under standard DOS.

Omniview provides two types of user interfaces: pop-up menus and command-line oriented. You can invoke the pop-up menu by pressing the Shift-Ctrl-1 keys. The main menu options essentially focus on managing multitasking, and they permit you to run a task from the applications list, switch between tasks, and add, delete, and change an application's specification from the current applications list.

Items Discussed

Concurrent DOS 386 2.0
for 3 users $395
for 10 users.....................$495
Digital Research
Box DRI
Monterey, CA 93942
(408) 649-3896
Inquiry 887.

DESQview 2.01..............$129.95
Quarterdeck Office Systems
150 Pico Blvd.
Santa Monica, CA 90405
(213) 392-9851
Inquiry 885.

Omniview 4.0................. $79.95
Sunny Hill Software
P.O. Box 55278
Seattle, WA 98155
(206) 367-0650
Inquiry 886.

PC-MOS 2.1
for 1 user $195
for 5 users $595
for 25 users.....................$995
The Software Link
3577 Parkway Lane
Norcross, GA 30092
(404) 448-5465
Inquiry 888.

VM/386 1.1 ....$245
IGC
4800 Great America Pkwy.
Santa Clara, CA 95054
(408) 986-8373
Inquiry 884.

Windows/386 2.1 ....$195
Microsoft Corp.
16011 Northeast 36th Way
P.O. Box 97017
Redmond, WA 98073
(206) 882-8080
Inquiry 883.

The applications list includes a small DOS (128K bytes), a big DOS (400K bytes to 600K bytes), Omniview's task status utility, and any other programs you may add. When you add the name of a program to the applications list, you specify a program title that begins with a two-letter hot key. For example, `WS - WordStar` is a title that also specifies the letters *WS* as the hot key. You can choose to run WordStar by simply typing *WS* when Omniview displays the applications list pop-up menu. Of course, you can also employ the cursor-control keys to select the applications you want to run.

The Omniview status option maps the presently loaded tasks and reports the memory size, base priority, current priority, and time slice for each task. Using a copy of DOS, I was able to locate the virtual files on my RAM disk where some of the applications are swapped. In addition, you can obtain a report from the system that shows you the amount of free memory, available virtual memory, and unused expanded memory.

Omniview's command-line version consists of five commands, one of which invokes the Omniview shell discussed above. With the other commands, you can start a task and run it in background mode; run a process with the option of switching it into the background; switch between processes; and display the status of the tasks and the amount of various types of free memory.

Concurrent DOS 386 supports up to four tasks. Each task starts with its own command-line prompt and occupies the entire screen. You can switch between tasks by pressing the Control and the 1, 2, 3, or 4 keys. Concurrent DOS 386 includes a file manager application that provides a DOS shell. The shell supports both DOS and CP/M-86 utilities. Concurrent DOS 386 adds new DOS commands related to file/directory deleting and copying. The file manager contains several windows of information: directory information, file information, a list of commands, and a map for the keyboard function keys.

When in the shell, you can use the file manager to navigate easily between drives and paths and perform various DOS functions, including running a program within that task. While Concurrent DOS 386 allows tasks to run concurrently, the screen output of background tasks overlays with the screen of the currently viewed task. This overlaid output severely limits the usefulness of Concurrent DOS 386 as a flexible multitasking environment to that of only a fast program switcher. To continue using the multitasking feature, you must program background tasks to beep and attract your attention.

Concurrent DOS 386 does not implement the various tasks as virtual protected machines. While I was running multiple applications, one of them crashed and caused my entire system to hang.

PC-MOS is a PC-DOS superset operating system that takes special advantage of the architecture of the 80386 chip. Thus, PC-MOS takes complete control and defines its rules from the ground up. For example, you start PC-MOS commands with a dot, although you can tell the system to absolve you from having to type the dot. When multitasking, you can use additional commands to launch,

continued

TrueVista™ Videographics Adapters

We Just Made Choosing Your Graphics Card

As Easy As 1,2,4.

You've probably seen our TrueVista products, or you've heard about their powerful features like the real-time frame capture, on-board TI 34010 coprocessor, large frame buffer, NTSC/PAL compatibility and more. Recently, we announced several new products in the series, each with unique potential for your applications from video to digital pre-press to image processing. So now, whether your choice is an AT-class platform or the Macintosh® II, you only need one source for your graphics needs, the TrueVista series. The chart below outlines several key differences in the 5 products.

TrueVista Series

FEATURES		ATVista 1M	ATVista 2M	ATVista 4M	NuVista 2M	NuVista 4M
BUS		AT	AT	AT	NuBus	NuBus
MAXIMUM	32 bits/pixel	512 x 512	1024 x 512	1024 x 1024	1024 x 512	1024 x 1024
ADDRESSABLE	16 bits/pixel	1024 x 512	1024 x 1024	2048 x 1024	1024 x 1024	2048 x 1024
RESOLUTIONS	8 bits/pixel	1024 x 1024	2048 x 1024	2048 x 2048	2048 x 1024	2048 x 2048
VMX EXPANSION		2-10 Mbytes	2-10 Mbytes	2-10 Mbytes	TBA	TBA
PRICE		$2995.	$4250.	$5995.	$4250.	$5995.

Now There's Software You Can Count On, Too.

To complete the equation, add in STAGE™, our comprehensive graphics environment for the 34010. Since STAGE is host-independent, it allows you to access the coprocessor directly, regardless of the bus. So your program on the AT can be quickly ported to the Macintosh II. Customers will not be tied to one platform either, as files and programs will be compatible across both hosts. STAGE is currently available for the ATVista series, and will be available soon for the NuVista as well.

With the new members of the TrueVista family and the release of STAGE, you now have everything you need to develop exciting new products for the next generation of computer graphics. And many applications are already appearing to assist you in your immediate needs. Contact us to learn more about our products or our third-party developer program and the support available to you. You'll soon see how you can count on Truevision to provide all your graphics solutions.

TRUEVISION® INC.

7351 Shadeland Station, Suite 100, Indianapolis, IN 46256 800/858-TRUE

INTERNATIONAL: Canada 416/499-9400 France 33-13-952-6253 Italy 39-2-242-4551 Switzerland 41-1-825-0949
U.K. 44-1-991-0121 West Germany 49-89-612-0010 Other 617/229-6900

Prices quoted are US Domestic suggested retail prices. Macintosh is a registered trademark of Apple Computer, Inc. ***Circle 227 on Reader Service Card***

© Truevision, Inc. 1988

Table 2: *Task specifications available in the 80386-based environments (●=yes; ○=no).*

	Windows/386	VM/386	DESQview	Omniview	Concurrent DOS	PC-MOS
User-defined title	●	●	●	●	○	○
EXE file	●	●	●	●	○	○
Subdirectory	●	●	●	●	○	○
Program parameters	●	●	●	●	○	○
Must invoke by a batch file only	○	○	○	○	○	●
Memory allocation						
Required	●	●	●	●	●	●
Desired	●	○	●	●	○	○
Expanded memory	○	●	●	●	●	○
Extended memory	○	●	○[1]	○	○	○[2]
Execution control						
Full screen	●	●	●	●	●	●
Background	●	●	●	●	●	●
Exclusive	●	●	●	●	●	●
Screen exchange						
Text	●	●	●	●	●	●
Graphics/text	●	●	●	●	●	●
Display options						
Window	●	○	●	○	○	○
Full screen	●	●	●	●	●	●
Task execution						
Suspend	●	●	●	○	●	●
Resume	●	●	●	○	●	●
Terminate	●	●	●	●	●	●
Reboot (single task)	○	●	○	○	○	○
Set priority	○	●	○	●	○	●
Set time slice	○	●	○	●	○	●

[1] Extended memory is handled as expanded memory by special drivers.
[2] Used by the MOS task manager itself.

remove, and manage a task. Every task launched has a task ID associated with it that acts as a handle. To switch between tasks, you hold down the Alt key while typing the digits of the task's ID. Each task occupies the entire screen. The main task has an ID of zero.

Table 2 compares the task-control features of the six packages. It reveals that most of these features are found in all these environments. Note that Windows/386, DESQview, and Concurrent DOS 386 do not let you assign priority levels and time-slice allocation to each task. VM/386 offers the most sophisticated task-control features; they go beyond simply assigning values for the time slice and task priority.

Windows/386 employs a special algorithm regarding the allocation of time slices to multiple tasks: Initially, the main task slows down when secondary tasks are launched. When the total number of tasks reaches a critical limit, more time is assigned to the main task, while the secondary ones slow down. From the DOS level of Concurrent DOS 386, you can simply flag whether a task can run in the background or not. Each running task is given a time slice in sixtieths of a second. You are not able to alter the time-slice value or assign task priorities.

Perks Included

Microsoft has included a number of applications with Windows/386 (the same ones included with the other Windows versions) to promote the environment use. Two major applications bundled with Windows/386 are Write—a scaled-down version of Word—and Paint, a mini-version that is similar to MacPaint. The Windows manual dedicates an adequate number of pages to illustrating how these applications are used. Other applications included are a notepad, a cardfile, a calendar, a calculator, a clock, a terminal emulator, and the Reversi game. These applications were developed to take advantage of Windows/386's style of user interface.

The VM/386 package does not include any special utilities, but this is not a detriment since the design philosphy of the product seems to let users keep employing their own utilities in the various virtual machines.

DESQview comes with an auto-dialer for Hayes-compatible modems and a keyboard macro utility. Both are accessed through the hierarchy of menus. Using the auto-dialer, you can make local phone calls or long-distance calls via AT&T, MCI, and Sprint. You can select the phone number either manually or from a list of numbers.

The Omniview package includes Super Macs, a keyboard macro utility program written in Turbo Pascal 4.0.

Concurrent DOS 386 includes the file-manager DOS shell, a cardfile application, and the EDIX text editor. The file manager is similar to XTree, a very nice DOS-shell product, and it employs a good user interface. The cardfile application is characterized by a visibly poor interface but good functionality.

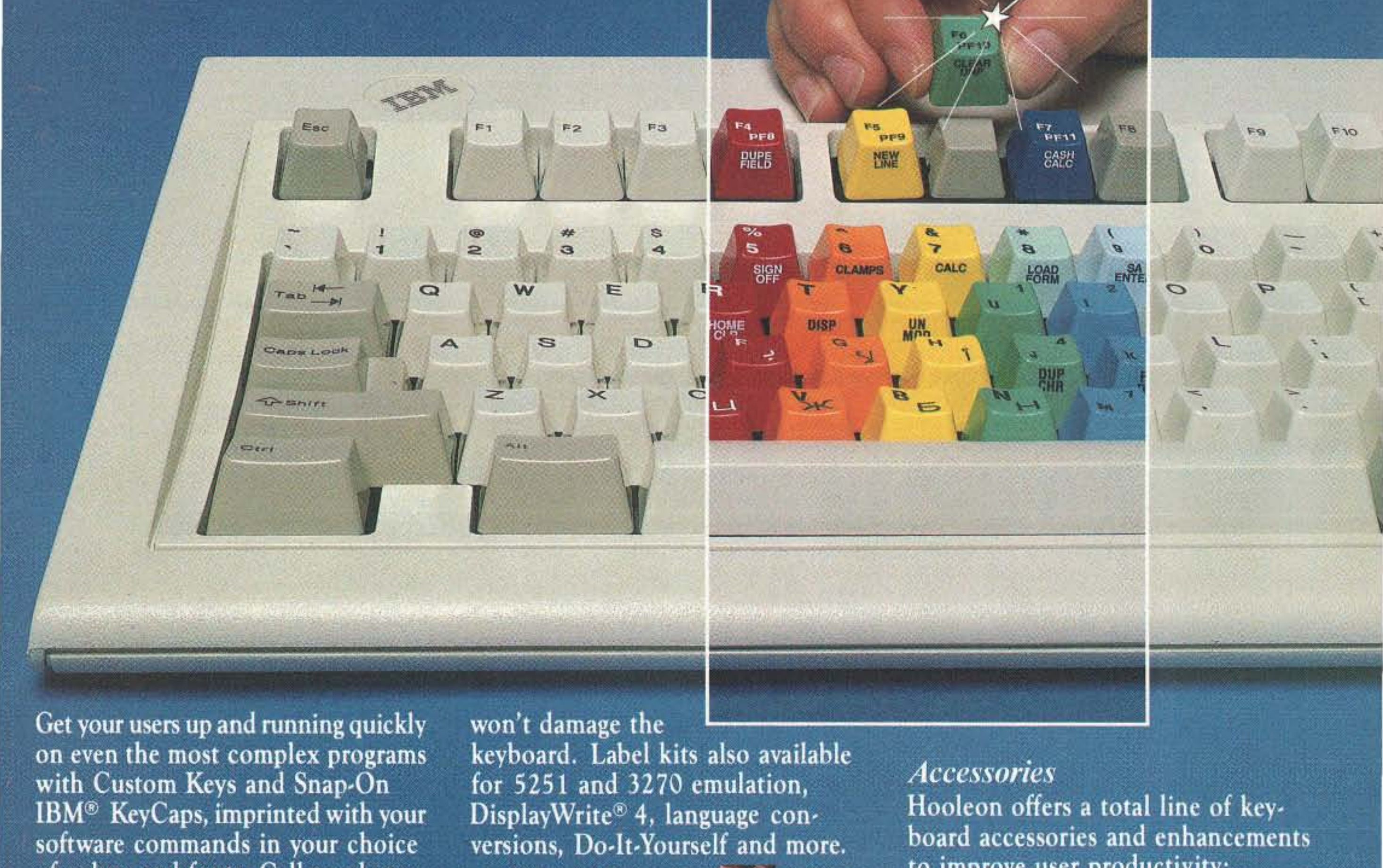
The designers of PC-MOS have sought to make it an independent 80386-based operating system. Consequently, it supports batch-file programming and offers its own text editor and debugger (with commands similar to those of DEBUG).

continued

Circle 106 on Reader Service Card (DEALERS: 107) →

Custom Key Imprinting

...Create a keyboard so easy to use, costly training time turns into instant productivity!



Get your users up and running quickly on even the most complex programs with Custom Keys and Snap-On IBM® KeyCaps, imprinted with your software commands in your choice of colors and fonts. Call our keyboard customizing specialists at 602 634-7515 for a professional solution to your training problems.

Keytop Labels

The professional quality alternative to key imprinting, Hooleon's custom Keytop and Keyfront Labels are precision-made to your print and color specs. They won't wear out or come off the keys until intentionally removed, and they won't damage the keyboard. Label kits also available for 5251 and 3270 emulation, DisplayWrite® 4, language conversions, Do-It-Yourself and more.

FlexShield™

Protect your keyboard from dirt, liquids, paper clips and damaging environments without restricting keyboard operation. These flexible, durable protectors prolong keyboard life without sacrificing keyboard feel or keystroke sensitivity. Available for most keyboard makes and models or custom-made to your specs.

Accessories

Hooleon offers a total line of keyboard accessories and enhancements to improve user productivity:

- Do-It-Yourself Function Key Templates
- KeyStopper Individual Key Lock-Outs
- Workstation and Printer ID Labels
- Home Row Key Indicators
- Much, Much More!!!

Write or call today for your *FREE CATALOG*

CATALOG HOTLINE: 800 628-2828, Ext. 650

To order or for custom information:
Call 602 634-7515 or FAX 602 634-4620

Displaywrite is a Trademark of IBM Corp.
IBM is a trade name for International Business Machines Corp.

Hooleon CORPORATION

from the Leader in Keytop Innovations...

P.O. Box 201, Dept. BYTE, Cornville, AZ 86325

Table 3: *The 80386-based environments at a glance (●=yes; ○=no).*

	Windows/386	VM/386	DESQview	Omniview	Concurrent DOS	PC-MOS
Graphics-based	●	○	○	○	○	○
Uses mouse	●	○	●	○	○	○
Uses extended memory	●	●	●	●	○	●
Pop-up control center	○	●	●	●	○	○
Offers file/direct management	●	○	●	○	●	●
Provides significant						
extension to DOS	●	○	○	○	○	○
replacement to DOS	○	○	○	○	●	●
Easily alternates between environment and standard DOS	●	●	●	●	○	○
Views concurrent tasks in multiple windows	●	○	●	○	○	○
Supports multiple users	○	○*	○*	●	●	●
API available	●	○	●	Some	○	○

* Planned for future releases.

Running Multiple Applications

The ability to run multiple applications is dependent on memory availability (basic, extended, and expanded), the environment's ability to manage the tasks' time slice and priority, and video output management. Regarding the availability of memory, I highly recommend that you install 1 to 2 megabytes of RAM (the more the better, but of course you have to consider the cost). Adequate available memory is half the solution.

The other half of the solution is dealing with the limitations you encounter when using memory-hungry applications. Two specific examples are language development environments such as Turbo Pascal and Turbo C. If you assign insufficient memory to these tasks, you may be able to load the environment and a program file, but you may not be able to compile. On the other hand, if you allocate a generous amount of memory to these language environments, you may limit the memory that permits you to run other applications, such as word processors.

If you plan to harness the power of multitasking to the fullest, then the task management capabilities of the environments become vital. With environments that offer little or no control for, at least, the time-slice and task-priority parameters, you have little control over task management. VM/386 and PC-MOS are in the forefront of the packages that deliver extensive task-control features. You can assign distinct values for the various concurrency-control parameters. The values of the task-control parameters depend on the number of concurrent tasks, their functional nature, and your need (or lack thereof) for certain tasks to quickly achieve their goals.

There is another aspect of running concurrent tasks that may seem trivial: video output control. Neither DESQview nor Concurrent DOS 386 stops full-screen applications running in the background from also sending screen output. You may find this situation a source of annoyance for many applications.

In these two programs, there are a few cases where a full-screen application—for instance, one that you might write or have a programmer customize—can run in the background. For example, the application may beep to signal the termination of a number-crunching phase. Another solution is to have the application display a status in a specific location of the screen. Alternatively, you may have the background applications send their status information to the printer or a text file—each message is accompanied by a task ID.

David versus Goliath

History seems to repeat itself. Consider the battle between the young, slim David and the huge Goliath, and the outcome that upset the odds: the Goliath of OS/2 against the David (or Davids) of the 80386-environments. Like the David of old, these new Davids have the 80386 chip to sling at the face of the modern Goliath. The various 80386-based environments (see table 3) should appeal to different groups of DOS users.

When it comes to setup requirements, the most flexible environments are Omniview and DESQview. Windows/386, VM/386, and PC-MOS require slightly more hardware. While Concurrent DOS 386 is able to run with 512K bytes, its inability to use extended memory (only expanded memory is employed) imposes very severe functional restrictions in the area of supporting concurrent tasks.

If you are looking for a graphics-based environment, then Windows/386 could meet your needs. Its resemblance to the OS/2 Presentation Manager may be regarded as an additional bonus if you also plan to use machines that run OS/2. VM/386, DESQview, and Omniview are environments that support virtual PCs. VM/386 provides you with sophisticated task control—a valuable feature if you plan to run concurrent tasks frequently and would like to fine-tune their execution speed. [Editor's note: *At press time, IGC had announced version 1.2 of VM/386, with support for DOS 4.0, additional networks, and printer sharing.*]

PC-MOS offers an alternative to the new OS/2 and to staying with standard DOS. As such, PC-MOS will most likely appeal to those who have highly specialized applications installed on corporate micros. If you have used earlier versions of Concurrent DOS and would like to continue with the 80386 version, then Concurrent DOS 386 meets your needs. The power of such environments succeeds in extending the longevity of standard DOS. ■

Namir Clement Shammas is a columnist for several computer magazines and a freelance writer living in Glen Allen, Virginia. He can be reached on BIX as "nshammas."

Circle 74 on Reader Service Card →

Unattended Tape Backup For All Your PCs

Now, Digital Products provides completely automatic, unattended tape backup for every PC in your department. For the first time, users enjoy worry-free, scheduled backup without having to do anything themselves:

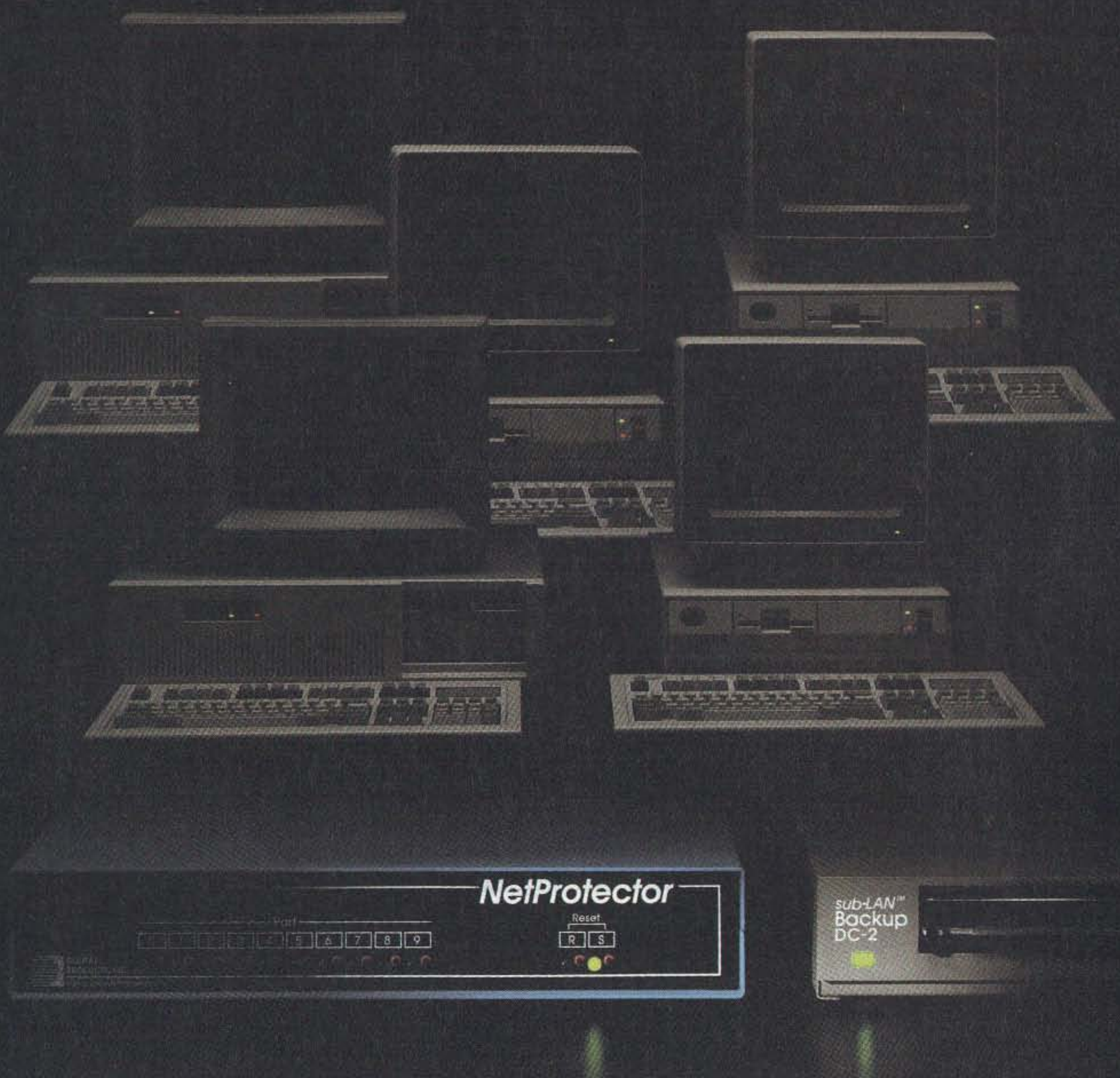
☐ automatic backup at night using the PC's clock
☐ complete data protection without the cost of a tape backup unit for each PC
☐ unattended operation—no user involvement
☐ flexible and easy scheduling
☐ industry standard backup software
☐ 100 or 150 Mb streaming tape capacity

Entire disk, data-only, program-only, updated data, specific files—any or every night—you choose the protection you need and we do the rest. Available as an option with the NetCommander™ sub-LAN product family—sub-LAN Backup™—or as a stand-alone backup system—NetProtector.™ With sub-LAN Backup, NetCommander now offers full data connectivity, data integrity, and data safety. Call us today for more information: **1-800-243-2333 or in California, 1-800-247-2006.**

DIGITAL
PRODUCTS, INC.
the sub-LAN™ company

108 Water Street, Watertown, MA 02172 617-924-1680

NetCommander, NetProtector, sub-LAN, and sub-LAN Backup are trademarks of Digital Products Inc.



The Hot Performers.

"Solid performance and low price make this system an excellent value."
—InfoWorld

ME 386-20

20 MHz 80386-20 processor ☐ Microsoft OS/2 and DOS compatible ☐ 1 MB 32-bit RAM running at "0" wait state (upgradable to 8 MB) ☐ Socket for 80387/80287 math co-processor ☐ High performance NCL floppy/hard disk controller ☐ 1.2 MB floppy disk drive ☐ CMOS clock/calendar with battery back-up ☐ Enhanced keyboard

$2350

Upright Case Add $300

ME 386-18

18 MHz 80386 processor ☐ Microsoft OS/2 and DOS compatible ☐ 512K 32-bit memory on board ☐ Two 32-bit expansion slots ☐ Socket for 80387 math co-processor ☐ High-performance NCL floppy/hard disk controller ☐ 1.2 MB floppy disk drive ☐ CMOS clock/calendar ☐ Enhanced AT keyboard

$1799

★ SPECIAL ★

WHILE THEY LAST!

ME V20 ☐ 64K (upgradable to 640K) ☐ 360K floppy disk drive ☐ Monochrome graphics card ☐ Monochrome monitor ☐ Keyboard ☐ Complete system... $499.00

ME 286-12

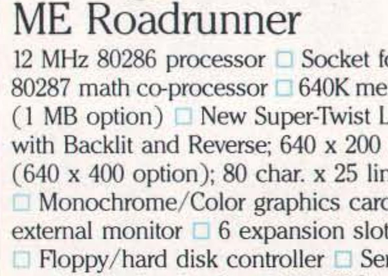
8/12 MHz 80286 processor ☐ 512K memory (upgradable to 1 MB on board) ☐ "0" wait state option (s.i. 15.3) ☐ Microsoft OS/2 and DOS compatible ☐ 8 I/O expansion slots ☐ High-performance NCL floppy/hard disk controller ☐ 1.2 MB floppy disk drive ☐ CMOS clock/calendar ☐ Enhanced keyboard

$899

The Network Solution

ELS Network for two-to-four users. Increase your company's productivity without making a big increase in expenditures. Complete software... **$499**

Call for all Novell Products



HOT PORTABLES

ME Roadrunner

12 MHz 80286 processor ☐ Socket for 80287 math co-processor ☐ 640K memory (1 MB option) ☐ New Super-Twist LCD with Backlit and Reverse; 640 x 200 dots (640 x 400 option); 80 char. x 25 lines ☐ Monochrome/Color graphics card for external monitor ☐ 6 expansion slots ☐ Floppy/hard disk controller ☐ Serial/-parallel/clock-calendar ☐ 1.2 MB floppy disk drive ☐ 20 MB hard disk (30, 40, or 60 MB optional) ☐ 12-function AT style keyboard ☐ 110/220V auto-switchable ☐ 20 pounds

$1799

Roadrunner Plus (386)

Intel 80387 processor ☐ 6/16 MHz clock speed ☐ 1 MB of memory ☐ Socket for math co-processor ☐ Floppy/hard disk controller ☐ 1.2 MB high capacity floppy disk drive ☐ 42 MB fast access hard disk (60 MB optional) ☐ Serial/parallel ports ☐ Color/mono display card for external monitor ☐ New Super-Twist LCD with Backlit and Reverse; 640 x 400 dots; 80 characters x 25 lines ☐ 6 expansion slots ☐ 12-function keyboard ☐ 110/220V auto-switchable ☐ 20 pounds

$3399

Prices and availability subject to change without notice.

VISA master charge

CALL TOLL-FREE

(800) MICRO-21

in Calif. (714) 662-1973

ME MICRO EXPRESS

2114 South Grand Avenue
Santa Ana, California 92705
Fax: (714) 662-1258 - Telex: 910 240 3029

Come See Us At COMDEX Booth #C607

Circle 138 on Reader Service Card (DEALERS: 139)

OS/2 COMMUNICATIONS

OS2COMM, a simple OS/2 communications program, proves that going on-line with OS/2 isn't necessarily that hard

Jim Gilliland

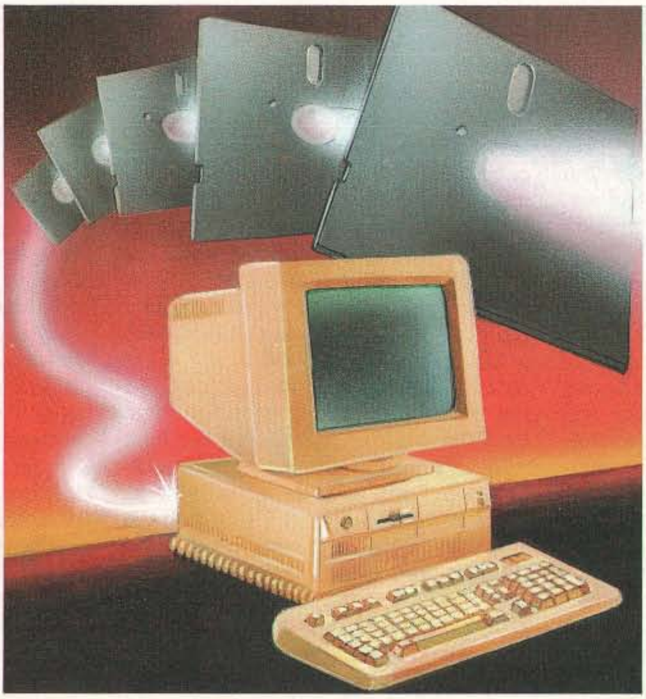
If you listen to people talk about the advantages of a multitasking environment like OS/2, you will invariably hear them give the example of downloading a file from a remote source while using a word processor, spreadsheet, or database. Of course, in order to do that, you need a communications program that runs under OS/2. If you can't find one, then you have to write your own.

Now, writing software that takes advantage of OS/2's advanced features is not a trivial task (see "Making the Move to OS/2," August BYTE). The sheer mass of the documentation for OS/2 is overwhelming; the OS/2 *Technical Reference* itself comprises some 1500 pages of text. For obvious reasons, many have concluded that programming under OS/2 will be a complex task.

Writing communications software under OS/2, then, would seem to be a doubly difficult assignment. Even with MS-DOS, developing communications software is tricky. The programmer must have intricate knowledge of the communications hardware and write code that not only interfaces to the communications port, but also works with the interrupt mechanisms of the CPU and its support circuits. If writing MS-DOS communications software is that hard, is it any wonder that many programmers expect writing communications software for OS/2 to be an enormously difficult job?

Yet nothing could be further from the truth. Writing asynchronous communications software under OS/2 is actually much easier than it was under MS-DOS. There are two reasons for this. First, the OS/2 COM device driver provides much better support for communications than was available under DOS. Second, the asynchronous communications process fits OS/2's multithread model very well.

Before I talk about communications with OS/2, let's take a look at how such things are done under MS-DOS.



DOS Talk: Interrupt-Driven

MS-DOS and BIOS offer some support for serial communications, but neither is very useful. Both are based on a simple polling mechanism that is completely unsuitable for high-speed communications. The DOS functions support only sending and receiving characters to and from the serial port. The BIOS adds functions for parameter setting and error checking. These routines can support communications at up to around 1200 bits per second, and no faster. If you need higher data transfer rates, you must use interrupt-driven communications, and that means you must write

continued

ILLUSTRATION: TOM CENTOLA © 1988

code that talks directly to the hardware.

The first step in writing an interrupt-driven routine is to initialize the transfer rate and other parameters within the universal asynchronous receiver/transmitter, the chip that directly supports the COM port. The UART used in the IBM family of microcomputers is the Intel 8250 and its successors, the 8250A, 16450, and 16550. There is a BIOS routine that you can use to initialize the UART, but on some machines it is bug-ridden, so most designers write directly to the relevant I/O ports instead.

After initializing the UART, you must put in an interrupt-service routine (ISR). This requires manipulating several bits in several control registers in both the UART and the 8259 Interrupt Controller chip. You must be careful setting these registers, as other processes can be affected if you change the wrong bits. The 8259 is especially vulnerable in this regard, because it handles every interrupt in the system.

To support high transfer rates, you must keep the ISR short. The incoming data should be placed in a circular buffer for later use by the main processing logic of the program, and the ISR should perform little additional work. Both the ISR and the main program must contain logic to deal with the data buffer.

As you can see, communications programming under DOS is a complex process. I haven't even mentioned the difficulties of the transmit logic, or XON/XOFF processing, or the various other issues just waiting to complicate an MS-DOS communications program.

The Privileges of OS/2

Under OS/2, the picture changes radically. It is just as necessary to use interrupt-driven code to provide high transfer rates under OS/2 as it is under DOS. But under OS/2, application code cannot service interrupts.

The OS/2 system uses several different levels of privilege for the code that runs under it. These different levels are referred to as "rings," with ring 3 having the lowest privilege and ring 0 having the highest. Ring 3, where almost all user code is executed, has no direct I/O access. Ring 2, which can be made available to user code under special conditions, can execute In and Out instructions but cannot service interrupts. And ring 1 is not used at all under OS/2.

This leaves ring 0 as the only privilege level capable of servicing interrupts. Only OS/2's kernel and the device drivers run at ring 0. But the design philosophy of OS/2 requires that the kernel contain no device-specific code, thereby keeping it consistent in all the various OS/2 implementations. Thus, the device driver is the only valid place for an interrupt handler.

OS/2 needs device drivers for all the hardware devices with which it is expected to work. OS/2 provides device drivers that support all the basic components of most desktop computer systems: keyboard, screen, clock, printer, disk drives, serial ports, and mouse. New drivers will be produced as needed for new peripherals, by either the system vendor or the peripheral vendor.

For communications, OS/2 comes with two COM drivers. One of them, COM01.SYS, supports COM1 and COM2 on the AT and the XT/286. The other, COM02.SYS, supports COM1, COM2, and COM3 on PS/2 systems. If you intend to run communications software under OS/2, you must specify the appropriate driver in your CONFIG.SYS file. From the point of view of the application, though, the two drivers are identical, so I won't differentiate between them from here on.

The OS/2 COM device driver is a well-designed and complete interface to the COM ports under OS/2. It is far more powerful than the corresponding COM support under MS-DOS. The Application Program Interface (API) to the driver uses the same set of system calls that would be used to read and write a file, plus one more that is used to set up communications parameters.

The device driver provides for all necessary hardware, including both the COM port hardware and the interrupt mechanism. It also services the device interrupt and provides support for the necessary character buffers. The driver handles both sides of the buffering process, leaving the application completely unaware of the buffering. The driver also supports XON/XOFF processing and offers a number of different ways to control and react to the various modem control signals. The driver provides full status reporting of both hardware and software.

Using the OS/2 COM driver eliminates almost all the complexity of dealing with the serial I/O hardware, since the device driver supplies all the hardware interface requirements that, under MS-DOS, have to be coded into the application. Thanks to the COM driver, you can develop a simple communications program using very little code.

Using the COM Driver

Using the COM device driver in an application program is remarkably easy. All you need are five OS/2 function calls, which are used as follows:

1. Use `DosOpen` to open the COM port.
2. Use `DosDevIOCtl` to set the relevant communications parameters.
3. Use `DosRead` to receive characters from the COM port.
4. Use `DosWrite` to transmit characters via the COM port.
5. Use `DosClose` to close the COM port when finished.

Let's look at each of these functions in a little more detail.

`DosOpen` opens the COM port. The actual name of the port (COM1, for example) is passed as the filename; other parameters should specify a normal, existing, read/write file being opened for exclusive access. The Open call will return a file "handle," which is then used to identify this device to the I/O Control, Read, Write, and Close calls. (In Gordon Letwin's book *Inside OS/2,* he calls this handle a "magic cookie," which means that it is a value that you simply accept from the system and give back when requested. You never need to care what the actual value is.)

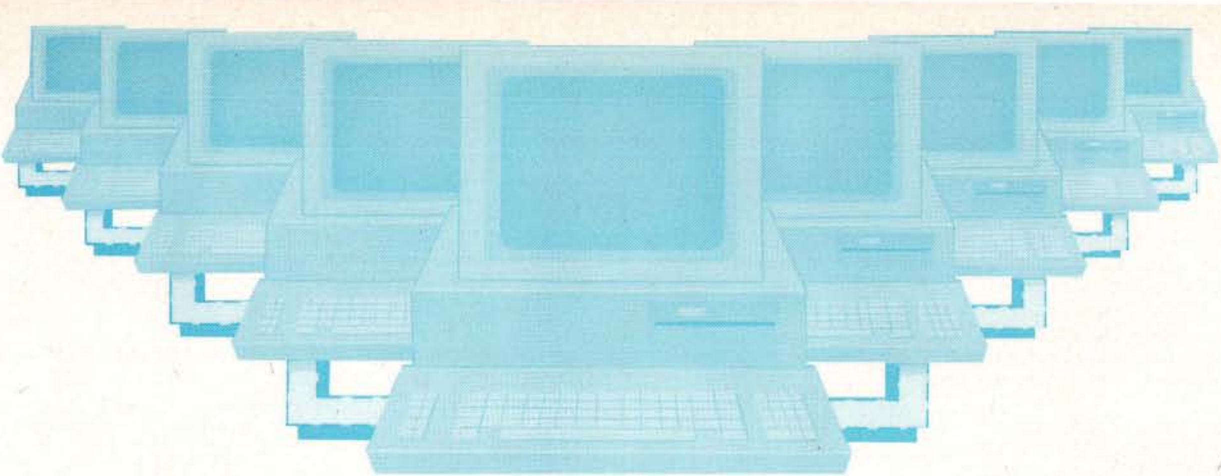
`DosDevIOCtl` allows an application to send control information to a device driver. The Standard Edition 1.0 of OS/2 defines 11 categories of I/O Control (`IOCtl`) calls, including floppy disk control, serial I/O control, printer control, and so on. Each of these categories is associated with a particular OS/2 device driver, and each has a set of functions and codes defined for that driver.

The functions for the COM driver fall under I/O Control category 1. These functions control communications parameters such as transfer rate and data bits, as well as various time-out parameters, whether XON/XOFF should be used, and how the RS-232C hardware signals should be used.

After all the necessary settings have been made via `DosDevIOCtl`, the COM port can be processed just like a file. `DosRead` retrieves data from the port, either a character at a time or a bufferfull at a time. You can use `DosWrite` in the same fashion—processing as many characters at a time as necessary. The `DosClose` function is the simplest of them all, requiring only the COM handle as a parameter.

For more information on the `DosDevIOCtl` functions and their parameters, you should consult the IBM *Technical Reference* for OS/2. While there are other books available that cover the tech-

continued



Tomorrow's LAN Solutions – Today.

EtherLAN Plus™/The Affordable Ethernet Solution

In today's LAN world, every new LAN manufacturer seems to have a new idea of what a network should be. Standards for the industry are few and far between, but are there if you want to pay for them. Wouldn't it be nice if for once you could buy a LAN system, at a price you can afford, and be fully compatible with the ethernet standard? Well now you can!

Turn Key Ethernet

EtherLAN is here to give you everything you need to set up an ethernet LAN system. You'll receive the EtherLAN network adapter, 25 feet of thinwire ethernet coax cable, T connector and easy to understand Installation and User's Guides, all for one low price. In addition to this, you'll also receive complete software needed to get your new EtherLAN system up and running quickly. You'll get NETBIOS software and also a complete network operating system to make using your new EtherLAN system even easier.

SimpleWARE™ Makes EtherLAN Unbeatable

The operating system you'll get works as a shell above DOS, so all your normal DOS programs will run on EtherLAN as well as locally. Even better yet, you can use standard DOS commands to control your network, so you are not stuck spending hours to learn a new set of commands. The operating system functions transparently, so you won't even know you're on a network.

Features You Can Rely On.

- Fully ethernet and cheapernet compatible (IEEE 802.3).
- Fast — a full 10,000,000 bit per second.

EtherLAN 6 Node Comparison

500 Kbytes	Read and Write	Retail
EtherLAN	11 and 10 seconds	$4199
3Com®	14 and 12 seconds	$5670*
Novell SFT®	10 and 9 seconds	$8265*

*Figures from PC Magazine.

- NO dedicated servers are required.
- Transparent operation —operates as a shell above DOS.
- Easy to use DOS type commands or pop up menus.
- Share disks, subdirectories, printers and plotters.
- DOS file and record locking.
- Up to 5 printers per server.
- Time and Date sharing.
- Electronic Message System.
- Low memory requirements.
- NETBIOS compatible.
- Everything you need is included at one low price.

The best news of all is the price.

At only $699.95 per node, you get all hardware, software, cabling and manuals needed.

Introductory Offer

Four Node Kit for only $2499.00. Save over $300.00.

With features like these, and an affordable price per node, how can you lose?

Call Toll Free
1-800-262-8010
1-714-529-8850 (in CA)

VISA VISA, M/C, COD, or Prepaid orders accepted. MasterCard

See us at COMDEX Booth #B1540

Simple Net Systems, Inc.

545 W. Lambert Rd., Suite A
Brea, CA 92621
FAX: (714) 529-2413

Requires IBM PC/XT/AT or compatible, running DOS 3.10 or higher. EtherLAN is a registered trademark of Simple Net Systems, Inc. Other brand and product names are trademarks of their respective holders.

Circle 202 on Reader Service Card (DEALERS: 203)

Listing 1: *OS2COMM.C version 1.2 is a simple communications program that runs under OS/2.*

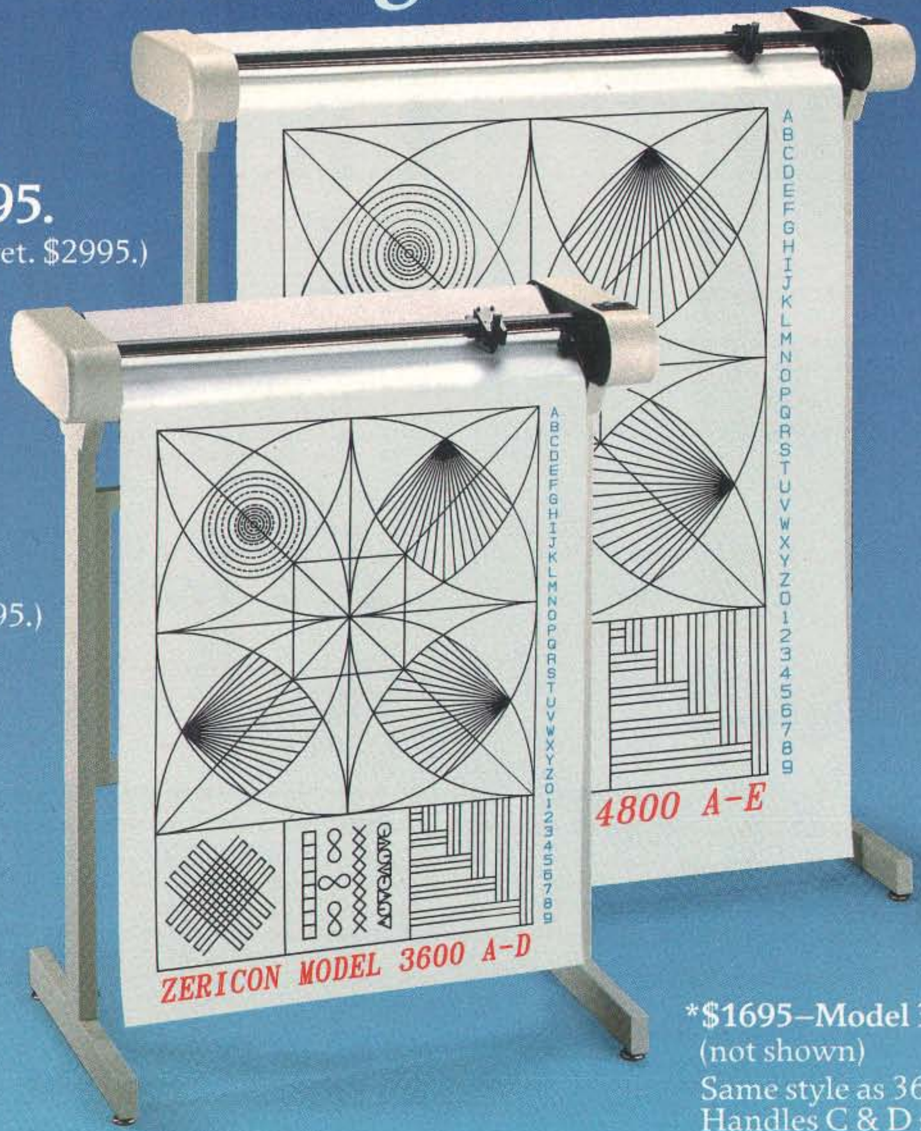
```
#define   LINT_ARGS
#define   INCL_BASE
#define   INCL_DOSDEVICES
#include  <os2.h>
#include  <stdio.h>
#include  <conio.h>
#include  <process.h>
#include  <malloc.h>
#define   STK_SIZE    1024

void main(int, char**, char**);
int      initcomm(int, char, int, int);
void far keytocom(void);
void far comtodsp(void);
int      parsarg(char*, char*, int*,
                 char*, int*, int*);
unsigned short    com, cfile;
unsigned int      cflag, ktcid, ctdid;
unsigned long far main_sem, far ctd_sem;

char *usage ="\nOS2Comm - usage is:\r\n"
"\n\tOS2COMM COMx:baudrate,parity,"
                "databits,stopbits"
"\n\twhere:"
"\n\t\t COMx     = COM1, COM2, or COM3"
"\n\t\t baudrate = 300,1200,2400,"
                  "4800,9600, or 19200"
"\n\t\t parity   = N,O,E,M, or S"
"\n\t\t databits = 5,6,7, or 8"
"\n\t\t stopbits = 1 or 2\r\n";

void main(argc, argv, envp)
int argc;
char **argv, **envp;
{
 char far *ctdstack, far *ktcstack;
 RESULTCODES retcodes;
 unsigned int act, baud, dbits, sbits;
 char parity, comport[8];

 puts("OS2Comm.c version 1.2");
 puts("Copyright 1988 by Jim Gilliland");

 if (argc < 2 || argc > 3)
    {  puts(usage);
       exit(1);     }

 if (parsarg(argv[1], comport, &baud,
             &parity, &dbits, &sbits))
    {  puts(usage);
       exit(1);     }

 /* Open com device driver: */
 if (DosOpen(comport, &com, &act,
             0L, 0, 0x01, 0x0012, 0L))
  {  fprintf(stderr,"\nError opening port");
     exit(1);  }

 /* Initialize com device driver: */
 if (initcomm(baud, parity, dbits, sbits))
  { fprintf(stderr,"\nPort setup error");
    exit(1);   }

 /* Open capture file, if specified: */
 if (argc > 2)
   if (DosOpen(argv[2], &cfile, &act,
               0L, 0, 0x12, 0x0022, 0L))
     { fprintf(stderr,"\nErr: %s\n",argv[2]);
       exit(1);     }
   else cflag = 1;
 else cflag = 0;

/* allocate stack for threads: */
 ctdstack = malloc(STK_SIZE);
 ktcstack = malloc(STK_SIZE);

 if (ctdstack == NULL || ktcstack == NULL)
    {  puts ("Unable to allocate stacks");
       exit(2);     }

 /* Create receive and display thread: */
 if (DosCreateThread(comtodsp, &ctdid,
                     ctdstack+STK_SIZE))
   { puts("Can't create COM receive thread");
     exit(1);     }

 /* Set semaphore to block main thread: */
 DosSemSet(&main_sem);

 /* Create transmit thread: */
 if (DosCreateThread(keytocom, &ktcid,
                     ktcstack+STK_SIZE))
   { puts("Can't create COM transmit thread");
     exit(1);     }

 puts("Alt-X will end this program");

 /* Set high priority for COM threads */
 DosSetPrty(2,3,0,ktcid); /* time-critical */
 DosSetPrty(2,3,1,ctdid); /* time-crit +1  */

/* Wait for clear semaphore (see keytocom) */
 DosSemWait(&main_sem, -1L);

/* Suspend the other threads before ending */
 DosSuspendThread(ktcid);
 DosSuspendThread(ctdid);

 /* Close com driver and capture file: */
 DosClose(com);
 if (cflag==1) DosClose(cfile);

 DosExit(1,0); /* Exit: end all threads */
}
/*******************************************/

void far comtodsp()
/* This routine is run as a separate thread */
{
 char comchar[512];
 unsigned int bytes, readerr, cnt;

 while (-1)   /* Do forever: */
 {
    /* read character(s) from COMport: */
    readerr = DosRead(com,comchar,512,&bytes);
    if (readerr)     continue;
    if (bytes == 0)  continue;

    /* Write character(s) to screen: */
    VioWrtTTy(comchar,bytes,0);

    /* write character(s) to capture file: */
    if (cflag == 1)
       DosWrite(cfile,comchar,bytes,&cnt);
 }
}
/*******************************************/

void far keytocom()
/* This routine is run as a separate thread */
{
 KBDKEYINFO keyinfo;
 int written;
 char charcode, scancode;
```

continued

Affordable Large Format Plotting Starting at $1695.*

A-E
$2695.
(sugg. ret. $2995.)

A-D
$2295.
(sugg. ret. $2695.)



*$1695–Model 3610 C/D
(not shown)
Same style as 3600 A-D
Handles C & D size media

Features that say value...

Economical: $1,000 less than other large format plotters.

Compatible: Operates with all popular CAD software supporting DM/PL.™

Multiple Media Sizes as small as 8½″ x 11″ or as large as 36″ x 48″ eliminates the need for a second plotter.

Practical speed you can really use: 10″ per second assures good drawing throughput while optimizing the speed at which most plotter pens can draw without skipping.

Repeatability and Resolution: .004 assures quality suitable for the most demanding applications including PCB artwork.

Vacuum Paper Hold Down guarantees perfect registration.

Unique: X&Y rescaling allows calibration to one part in 10,000. Ideal for applications where scale is critical.

CALL NOW AND WE'LL SEND YOU A FREE SAMPLE PLOT.

(415) 490-8380 Fax (415) 490-3906

Dealer inquiries invited.

ZERICON

40491 Encyclopedia Circle
Fremont, California 94538

Made in USA

DM/PL is a trademark of Houston Instrument

Circle 233 on Reader Service Card

```
 while (-1)   /* Do forever: */
 {
   KbdCharIn (&keyinfo, 0, 0);
   charcode = keyinfo.chChar;
   scancode = keyinfo.chScan;

   /* Alt-X indicates End-Of-Processing: */
   if (charcode == 0x00 && scancode == 0x2D)
      {
      /* Clear Main semaphore:  */
      DosSemClear(&main_sem);
      continue;
      }

   /* skip Alt-keys & F-Keys: */
   if (charcode == 0x00) continue;

   /* Write character(s) to com port: */
   DosWrite(com, &charcode, 1, &written);
 }
}
/*********************************************/

int initcomm(baud,parity,dbits,sbits)
char parity;
int baud, dbits, sbits;
   /* this routine used by main thread */
{
struct {
  unsigned char databits, parity, stopbits;
  } linechar;

struct {
  unsigned char onmask, offmask;
  } modemctrl;

struct {
  unsigned int wtime, rtime;
  unsigned char flags1, flags2, flags3;
  unsigned char errchar, brkchar;
  unsigned char xonchar, xoffchar;
  } dcb;

int comerr, act;

 /* Set bitrate: */
 if (DosDevIOCtl( NULL, (char *)&baud,
                        0x41, 01, com))
   { fprintf(stderr,"\nBitrate error");
     return(1);     }

 /* Set databits, stopbits, parity: */
 if (parity == 'N') linechar.parity = 0;
 if (parity == 'O') linechar.parity = 1;
 if (parity == 'E') linechar.parity = 2;
 if (parity == 'M') linechar.parity = 3;
 if (parity == 'S') linechar.parity = 4;
 if (sbits == 2) linechar.stopbits = 2;
 if (sbits == 1) linechar.stopbits = 0;
 linechar.databits = dbits;
 if (DosDevIOCtl( NULL, (char *)&linechar,
                        0x42, 01, com))
    { puts("Line characteristics error");
      return(1);     }

 /* Set modem control signals: */
 modemctrl.onmask  = 0x03; /* DTR & RTS on */
 modemctrl.offmask = 0xff; /* nothing off */
 if (DosDevIOCtl( (char *)&comerr,
       (char *)&modemctrl, 0x46, 01, com))
     { puts("Modem control error");
       return(1);     }

 /* Set com device processing parameters:  */
 dcb.wtime = 100; /* 1sec transmit timeout */
 dcb.rtime = 100; /* 1sec receive  timeout */
 dcb.flags1 = 0x01;  /* enable DTR,         */
 dcb.flags2 = 0x43;  /*    RTS, XON/XOFF    */
 dcb.flags3 = 0x04;  /* recv timeout mode   */
 dcb.errchar = 0x00; /* no error translate */
 dcb.brkchar = 0x00; /* no break translate */
 dcb.xonchar = 0x11;  /* standard XON   */
 dcb.xoffchar = 0x13; /* standard XOFF */
 if (DosDevIOCtl( NULL, (char *)&dcb,
                        0x53, 01, com))
     { puts("Device control block error");
       return(1);      }

 return(0);
}

int parsarg(arg,port,baud,parity,dbits,sbits)
char *arg, *port;
char *parity;
int *baud, *dbits, *sbits;
    /* this routine used by main thread */
{
  int strptr;
  char strhold[8];
  strupr(arg);   /* cvt to uppercase */

  /* Parse cmdline for COM port: */
  if ((strptr = strcspn(arg,":")) == 0)
                                  return(1);
  if (strptr > 8) return(1);
  strncpy(port, arg, strptr);
  *(port+strptr) = '\0';
  arg = arg+strptr+1;

  /* Parse for cmdline baudrate: */
  if ((strptr = strcspn(arg,",")) == 0)
                                  return(2);
  strncpy(strhold, arg, strptr);
  *(strhold+strptr) = '\0';
  *baud = atoi(strhold);
  if (*baud != 300 &&  *baud != 1200 &&
      *baud != 2400 && *baud != 4800 &&
      *baud != 9600 && *baud != 19200)
                                  return(2);
  arg = arg+strptr+1;

  /* Parse cmdline for parity: */
  if ((strptr = strcspn(arg,",")) == 0)
                                  return(3);
  *parity = *(arg+strptr-1);
  if (*parity != 'N' && *parity != 'O' &&
      *parity != 'E' && *parity != 'M' &&
      *parity != 'S')             return(3);
  arg = arg+strptr+1;

  /* Parse cmdline for databits: */
  if ((strptr = strcspn(arg,",")) == 0)
                                  return(4);
  *dbits = *(arg+strptr-1) - '0';
  if (*dbits != 5 &&   *dbits != 6 &&
      *dbits != 7 &&   *dbits != 8)
      return(4);
  arg = arg+strptr+1;

  /* Parse for stopbit value: */
  if ((strptr = strcspn(arg,",")) == 0)
                                  return(5);
  *sbits = *(arg+strptr-1) - '0';
  if (*sbits != 1 && *sbits != 2) return(5);

  return(0);
}
```

June 17, 1988

Mr. Thomas C. McNamara
President
McNamara Productions
334 Santa Clara Drive
Pennsburg, CA 19453

Dear Tom:

What a great meeting! Our sales force is charged up, excited, and ready to take on the world.

It was a job more than well done. It was superb.

Sincerely,

Robert H. Kenny
President

Why build a printer that can print standing on its head when all you want is outstanding letter quality?

The answer is better quality printing.

We made our new 300 Series 24-pin printers more rugged than they have to be and more reliable than ever. We built in a patented optical sensor and linked it with a unique rack and pinion printhead drive.

So you get more accurate printhead positioning. And that means outstanding letter quality.

All in a printer so stable it works upside down.

```
But even right side up, you get
letter quality printing this good.
```

Our engineers call this "championship specs." More than 3 million loyal users call it rugged reliability. And it shows in the quality and performance of every printer and modem we make.

Call 1-800-OKIDATA for the dealer nearest you.

Circle 157 on Reader Service Card

OKIDATA®
an OKI AMERICA company
We put business on paper.

OKIDATA is a registered trademark of Oki America, Inc.
Marque déposée de Oki America, Inc.

File Transfer with OS2COMM

At present, OS2COMM merely allows you to establish a link between an OS/2 system and another computer. In order to make the program most useful, a file-transfer enhancement would be desirable. One way to add this feature is to build the transfer protocol into a separate program.

Here's how the technique works. The parent process uses the `DosDupHandle` function to associate the COM port with both `STDIN` (file handle 0) and `STDOUT` (file handle 1). It then uses `DosExecPgm` to initiate the transfer program as a child process.

Since a child inherits its parent's open files, the `STDIN` and `STDOUT` handles will be pointing to the COM port when the child protocol program receives control. The child process needs to open only the file to be sent or received (the name can be passed as a command-line parameter), and to process the transfer via the `STDIN` and `STDOUT` handles.

The beauty of this technique is that you can build the child process as a simple program that opens just one file and uses the standard I/O handles for the actual transfer of data and the related ACK/NACK blocks. It doesn't even have to realize that it's reading from and writing to a COM port.

For further discussion of this technique, see chapter 4 of Gordon Letwin's *Inside OS/2*.

Of course, other possibilities exist. It should be fairly straightforward (if less flexible) to build the transfer protocols into the main program. Also, it would be feasible to build the protocols into a dynamic-link library, allowing more than one application program to use them. It's not obvious, however, that this would provide any more flexibility than the `DosDupHandle` approach.

Since I have not (yet) tried any of these techniques, I will not presume to know which one of them is best in a given situation.

---

nical details of OS/2, I have not seen any that discuss this particular topic in adequate depth.

Triple-Thread Communications

The OS/2 multitasking model offers several methods for concurrent processing of multiple tasks. The simplest multitasking method uses OS/2 *threads,* units of work that together make up the OS/2 process. Using threads is the most appropriate method for implementing multitasking in serial communications. This is because the basic communications process is made up of two inherently asynchronous processes: getting keystrokes from the keyboard and sending them to the COM port, and getting characters from the COM port and sending them to the display. Since the program has no way to tell when the user might press a key, nor when the COM port may receive a character, a simple design approach is to set up a separate thread for each process and let the OS/2 dispatcher control which thread runs at any given time.

I've written a simple telecommunications program, OS2COMM.C, which works in exactly this manner (see listing 1). The program doesn't have any fancy features like automatic dialing, file transfer, and so on, but it does let you emulate a simple terminal and establish a link with another computer.

OS2COMM.C version 1.2 is written in C and uses both C library functions and OS/2 function calls. You can compile it using either the IBM C/2 compiler or the Microsoft C 5.1 compiler. It uses OS/2 multitasking features, so it will not run under MS-DOS or OS/2's DOS mode. After you've compiled OS2COMM, you invoke it as follows:

```
OS2COMM COMx:baudrate,parity,
  databits,stopbits capture-
    filename
```

The `capture-filename` is optional, but the other arguments are required and shouldn't have any blanks between them.

How OS2COMM Works

I designed OS2COMM for simplicity, to demonstrate how easy it is to use OS/2's COM driver. The program uses three threads (see figure 1). The first thread, `main`, does all the housekeeping and then creates the two threads that perform the actual communications processing.

One of these threads, `comtodsp`, simply reads the COM device for characters received and then displays them on the screen. The other thread, `keytocom`, reads the keyboard and sends the characters to the COM port.

Each of these threads has some noteworthy features. The main thread parses the command arguments (using the `parsarg()` function) to determine the communications parameters. The main thread then `DosOpen`s the COM port and uses the `initcomm()` function to perform the `DosDevIOCtl` function calls described earlier.

The `main` thread then opens the "capture" file, allocates stack memory for the other threads, and creates them (using `DosCreateThread`). Then it places the other threads into the time-critical priority class. Next, it sets a semaphore and blocks on it, waiting for the `keytocom` thread to clear it. It will wait in this state until you are ready to end the program. After being released by `keytocom`, the main thread will close the COM port, close the capture file, and force all threads to exit (using `DosExit`).

The `comtodsp` thread, though quite short, also contains some items worth discussing. First, note that the `DosRead` function will never block completely on the COM port. After some amount of time (the time-out value set in `initcomm`) with no character received, it will return with a count of 0 bytes read. The program must test for this possibility and react accordingly. Also, note that this routine contains code to write the received characters to the disk-capture file.

The only special feature of the `keytocom` thread is that it clears the main semaphore when the user types Alt-X (scancode 2Dh). This semaphore blocks the main thread, and clearing it here allows the main thread to resume execution. The main thread then terminates, taking the other two with it, and the program ends.

OS2COMM uses "Wait for something" read-time-out processing. This allows it to use a relatively large (1-second) read time-out, and still echo keystrokes quickly. Keystrokes are echoed to the screen only after they have been received by the device at the other end of the communications line and have been echoed back as incoming data. OS2COMM does not have a "local echo" capability (though it would be easy to add one).

Bells and Whistles

OS2COMM is about as simple as it could possibly be while still performing a useful communications function. The program contains none of the amenities you would usually expect in a PC communications program. I designed it to provide a clear view of the process necessary to make communications work. Within its limited function, the program works re-

continued

NEWS

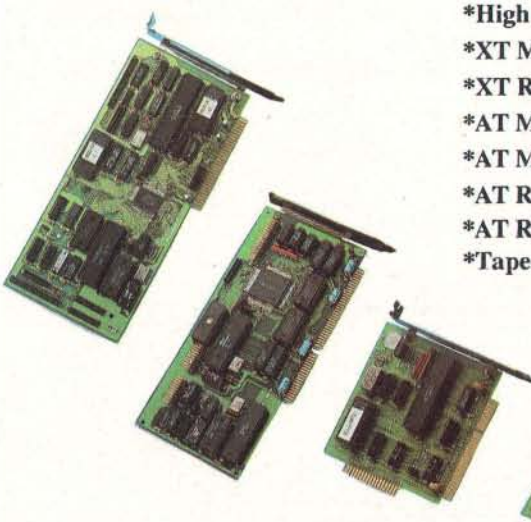
LONGSHINE

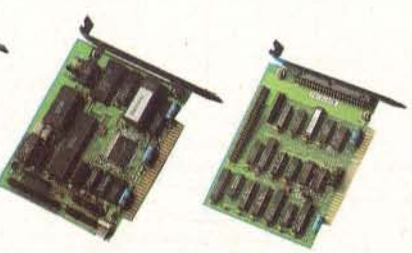
Designer & Manufacturer

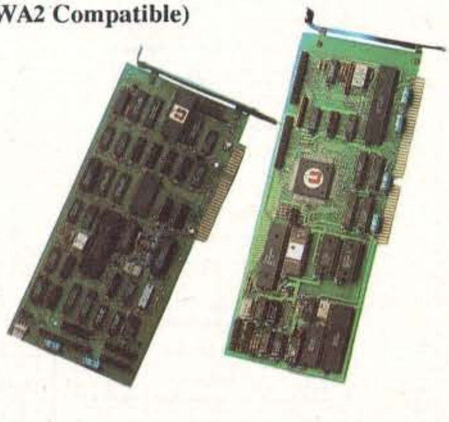
*QUALITY
*SERVICE
*VALUE

TOP 3 Hard Disk Controller Manufacturer

***XT MFM Hard Disk Contoller**
***High Density Floppy Disk Controller**
***XT MFM Hard/Floppy Disk Controller**
***XT RLL Hard Disk Controller**
***AT MFM Hard Disk Controller (WAH Compatible)**
***AT MFM Hard/Floppy Disk Controller (WA2 Compatible)**
***AT RLL Hard Disk Controller**
***AT RLL Hard/Floppy Disk Controller**
***Tape Controllers**



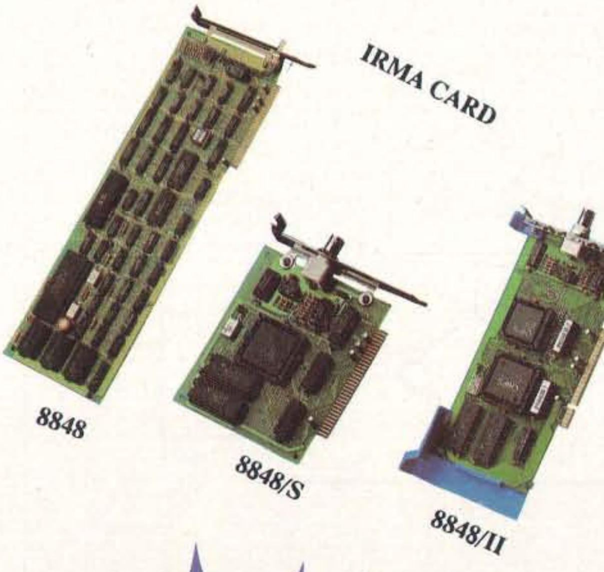


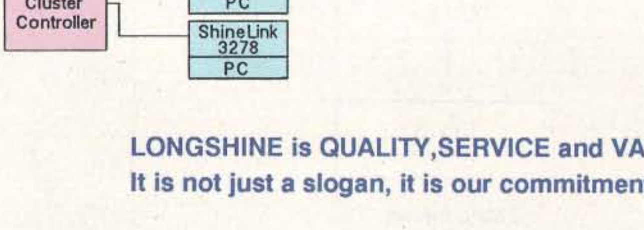


Micro-to-Mainframe Link ?

LONGSHINE Offers Easiest Solution

ShineLink 3278 is an IBM 3278/79 terminal emulator card for IBM PC/XT/AT or PS/2 computers. It is fully IRMA and IBM compatible. LONGSHINE supports emulation program and file transfer programs under TSO, CMS and CICS.





LONGSHINE is QUALITY,SERVICE and VALUE.
It is not just a slogan, it is our commitment.

We also have
*Modems (1200/2400,cards/systems)
*EEMS RAM CARDS
*Video Graphics Adapter
*LAN Cards (Ethernet, Cheapernet)
*Unix/Xenix Multi-Terminal Card

LONGSHINE Technology Inc.
2013 N. Capitol Ave.
San Jose, CA 95132
Tel:(408)942-1746 Fax:(408)942-1745
Telex:910-258-2016 LSTI

Circle 129 on Reader Service Card

Trademark:IBM PC/XT/AT,PS/2,TSO,CMS,CICS:IBM Corp.
WAH,WA2:Western Digital, IRMA:Digital Communication Associations

liably. Clearly, though, there is much room for enhancement.

Arguably the most important enhancement, though perhaps not the most obvious, is error detection. OS2COMM contains almost no error checking. Almost all the OS/2 API calls can return an error code, and these are largely ignored within this program. If you were to use OS2COMM (or a program like it) in a commercial product, then you would need to include code to test for return codes on all the OS/2 calls used. You can also use `DosDevIOCtl` to check for specific communications errors.

Features like parameter-setting dialogues, dialing directories, and script languages would also be useful additions to OS2COMM. Certain other features (such as editors, file browsers, and the ability to exit to the operating system) don't make sense in the OS/2 environment; since OS/2 lets you perform these functions with a separate application while the communications program continues in the background, there is really no point in building them into your program.

File-transfer protocols would be an-

continued

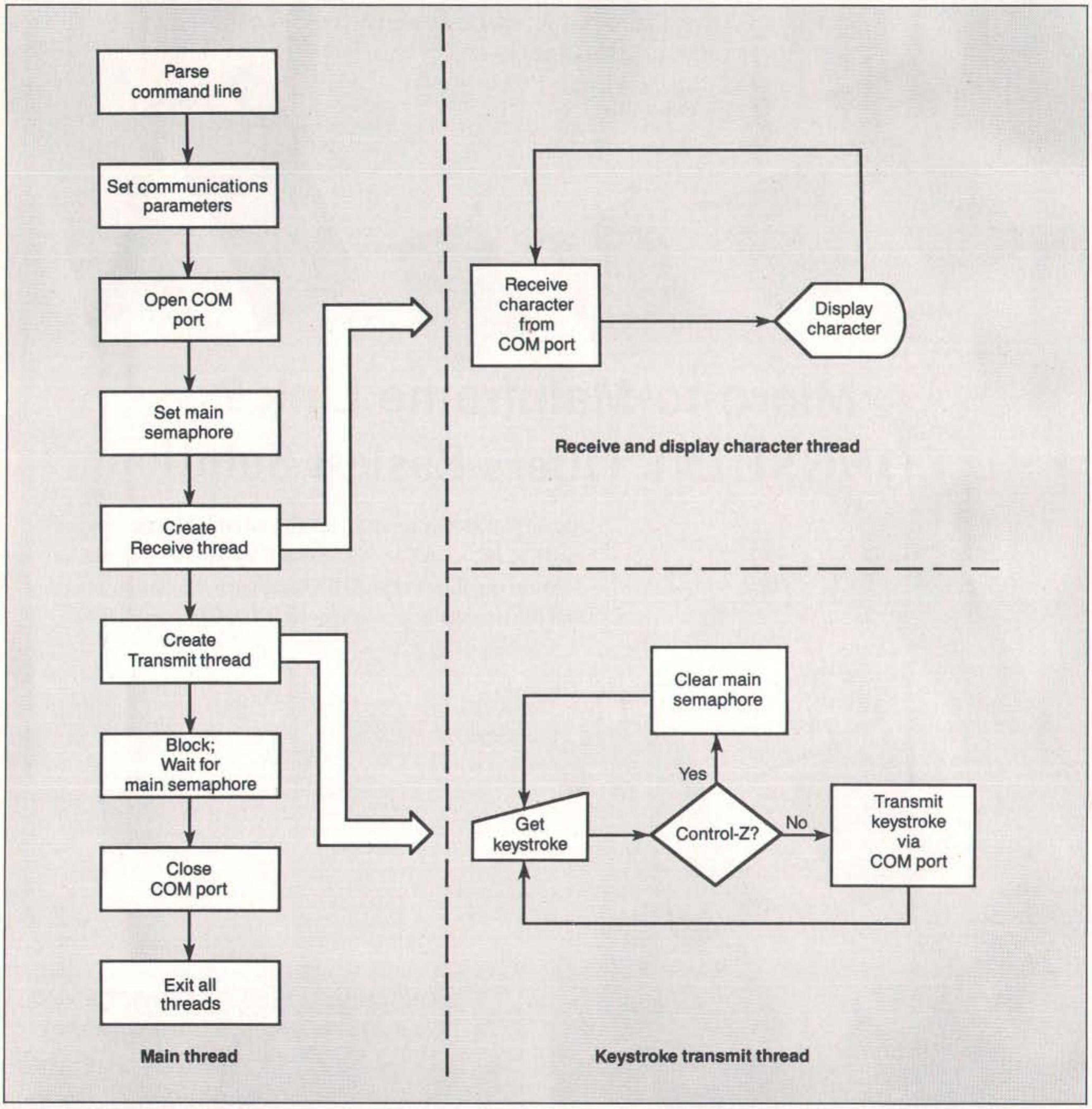


Figure 1: *The main thread of OS2COMM creates two additional threads that do the actual communications processing:* `comtodsp` *receives characters from the COM port and displays them on the screen, and* `keytocom` *reads keystrokes from the keyboard and sends them to the COM port.*

GRASP

Animation tools
that "far outshine
those of other popular
graphics presentation
packages."
—*PC Resource*

Program in the
4th Dimension...

ANIMATE!

Get unlimited action and interaction with the most powerful PC animation system available, by calling Grasp routines from your programs in C, Pascal, Basic, and other languages.

Or develop your graphics applications directly in Grasp! Take advantage of

- 74 animation & effects commands
- 25 predefined fades
- single-command animation
- all major graphics modes
- screen capture and graphics printing utilities

Includes Pictor, a full-featured paint program, completely integrated with Grasp for fast development and editing of programs and graphics.

GRASP 3.1
$149

GRaphic Animation System for Professionals

Convince yourself!
Send us $2.00 for Episode I
"The Adventures of Ferguson Floppy"

Paul Mace
SOFTWARE

400 Williamson Way
Ashland, OR 97520
800-523-0258

other very useful enhancement. They could be implemented in several different ways. One approach is to build the transfer protocols into a set of separate programs. (See the text box "File Transfer with OS2COMM" on page 160.)

There is one other point you should consider before attempting to add any new features, though. The design I've presented here uses three threads—one is for general housekeeping; the other two have very specific purposes. You must consider the program design carefully before adding new features. Take, for example, script processing. A script language requires access to both the transmit and receive data streams. Since these are processed in different threads, implementing script processing is awkward. Several solutions to this dilemma are possible, but the point you should not miss is that a multitasking design introduces a whole new way of looking at program-design issues.

Another multitasking concern is brought up by the current generation of language tools. The C compilers for OS/2 from Microsoft and IBM are excellent products, but the library functions supplied with them are not fully reentrant, which means that only one thread can use a given function at a time. A multithread program design requires careful attention to the possibility of one thread entering a library function while that function is in use by another thread. Version 5.1 of the Microsoft compiler provides an awkward method for dealing with the reentrancy problems, but I hope the next version of the compiler will provide libraries that are fully reentrant.

What Price Performance?

The topic of OS/2 performance has been widely discussed in the computer press, though much of the discussion has been based on speculation. Performance is an important issue with any computer system, and it has significant effects on communications processing.

One problem unique to the 80286 processor makes communications performance an even more important issue under OS/2. OS/2 uses the 80286 in protected mode, but it must shift back to real mode when processing DOS-mode applications. Unfortunately, the 80286 does not provide any easy mechanism for this shift, so you must reset the CPU to get back to real mode. This mechanism has been described as "turning off the engine to change gears," and it is a remarkably clever solution to this particular 80286 shortcoming. Nevertheless, it poses a problem for communications software.

The problem is that this shift takes a relatively long time—up to a millisecond, according to Gordon Letwin—during which time interrupts are disabled. The COM port hardware can retain one character that it receives during this period, as long as a second character does not arrive before interrupts are serviced again. Thus, one character arriving during the transition causes no problems, but the second one has a chance of getting lost.

I've taken a good look at the transfer rates you can use in an OS/2 multitasking environment. I ran a series of tests between an IBM PS/2 Model 80 (16-MHz 80386) and an IBM PC AT Model 339 (8-MHz 80286), both running OS2COMM at transfer rates of 2400, 4800, 9600, and 19,200 bps. (I used a Rolm CBX, with no modems, to connect the systems. Both machines were running under OS/2 version 1.0, with `maxwait` set to its default of 3 in the CONFIG.SYS file.)

The tests involved sending a 20K-byte file between the two systems. I ran each test in both directions, from the PS/2 to the AT and vice versa, so I could see the differences between 80286 and 80386 performance. In each test, the transmitting computer ran only OS2COMM. During some tests, I had the receiving system run a compile-and-link task concurrently with the communications task. This created a realistic multitasking situation, since a compiler alternates between being CPU-bound and I/O-bound and uses both I/O and CPU resources heavily.

Even before examining the test results, we can estimate what results we should expect by looking at the actual times necessary to transmit a character at either 9600 or 19,200 bps. Let's assume an 8-bit character with no parity, one start bit, and one stop bit, for a total of 10 bits transmitted per character. (10 bits per character also applies to 7-bit data with parity.) So at 9600 bps, you can transmit a maximum of 960 characters per second. Taking the reciprocal, single characters should arrive no more frequently than one every 1.04 ms.

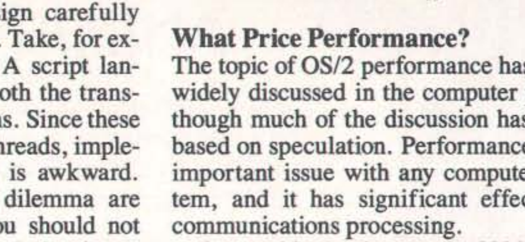
Similar arithmetic for 19,200 bps suggests that characters will arrive at a maximum frequency of one every 0.52 ms. Assuming that the mode-switch time of 1

continued

With THIRD® you can go from this equation:

5*COS(X*(1/X))+(10*EXP(SIN(X)))-(X^3)=F(X)

To this graph:



In just 5 min. or less!

(On an IBM XT, including setup time.)

THIRD® is a computer language created for science and mathematics which includes integrated functions for:

- SOLVING EQUATIONS
- GRAPHING FUNCTIONS, THEIR DERIVATIVES AND INTEGRALS
- WORKING WITH COMPLEX NUMBERS
- READ AND CONTROL LABORATORY INSTRUMENTS
- COMMUNICATING WITH OTHER COMPUTERS

PLUS

YOU CAN EASILY CUSTOMIZE TO YOUR OWN APPLICATIONS
Working demo diskette (specify 3.5" or 5.25") $5, VISA, MC
Min. hardware requirements: IBM PC or Comp., 256K, (2) 360 disk drives, CGA, Dos 2.2.
Also for IBM PS/2 and IBM RT/PC.

TRILOBYTE INC.
596 Abolición St., Hato Rey, P.R. 00918 / TEL. (809) 767-1839

Circle 226 on Reader Service Card

" The Maximum Performance Computer "

286 12MHz SYSTEM

80286 6/12MHz SYSTEM BOARD
ZERO WAIT STATE
TEAC 1.2M FLOPPY DRIVE
FDD/HDD CONTROLLER
101-KEY ENHANCED KEYBOARD
0 K
FCC CLASS 'B' APPROVED

* ALL SYSTEMS DO NOT INCLUDE RAM. PLEASE CALL FOR CURRENT PRICES.

$745.00

6/16 MHz SYSTEM $945.00
SAME CONFIGURATION AS THE 12MHz SYSTEM ABOVE

Reliable! *Powerful!*

Over 15,000 pcs 286 systemboards sold monthly

386 20MHz SYSTEM

80386 16/20 MHz SYSTEM BOARD
ZERO WAIT STATE
TEAC 1.2M FLOPPY DRIVE
FDD/HDD CONTROLLER
101-KEY ENHANCED KEYBOARD
1MB RAM
EGA ADAPTER
2 SERIAL & 2 PARALLEL PORTS
FCC CLASS 'B' APPROVED

$2,395.00

OPTIONS

HARD DRIVES

SEAGATE	MINISCRIBE
ST-125	3650 6128
ST-138	3675 8425
ST-225	3053 8438
ST-238	3085 9380E
ST-251	6085
ST-251-1	
ST-4096	

FLOPPY DRIVES

TEAC -
360K, 720K, 1.2M, 1.44M

TOSHIBA -
360K, 720K, 1.2M, 1.44M

MITSUMI -
360K, 1.2M

MONITORS

TAXAN
MITSUBISHI
NEC
TATUNG
GOLDSTAR

ADD ON CARDS

M/G/P
C/G/P
EGA
I/O CARD FOR XT & AT
MEMORY EXPANSION CARD

GENOA
EGA (800 X 600)
VGA (800 X 600) 256K
VGA (1024 X 768) 512K

** Distributor for TEAC, TOSHIBA, MITSUMI, GENOA, TAXAN & TATUNG. OEM WELCOME*

P321SL - 216 CPS	$ 520.00
P321SLC - COLOR	$ 700.00
P341SL - 216 CPS	$ 675.00
P351SX - 360 CPS	$1,150.00
P351C - COLOR	$1,200.00
PAGE LASER12	- CALL -

TOSHIBA

TOSHIBA

TOSHIBA

PORTABLE PERSONAL COMPUTER

T1000 - 80C88, 4.77MHz, 6 LBS.	$ 775.00
T1200F - 80C86, 9.54MHz, 11 LBS.	$1,425.00
T1200FB - 80C86, 9.54MHz, BACKLIT LCD	$1,550.00
T1200H - 80C86, 9.54MHz, 10 LBS.	$2,245.00
T1200HB - 80C86, 9.54MHz, BACKLIT LCD	$2,400.00
T3100/20 - 80286, 8MHz, 15 LBS.	$2,880.00
T3200 - 80286, 12MHz, 18 LBS.	$3,695.00
T5100 - 80386, 16MHz, 15 LBS.	$4,795.00

DEALER & OVERSEAS INQUIRES WELCOME

MAX GROUP CORPORATION

600 MONTEREY PASS ROAD MONTEREY PARK CALIFORNIA 91754 (818)300-8406
1375 B 16TH ST. FORT LEE NEW JERSEY 07024 (201)944-0040
1325 RTE 130 SOUTH, STE. #F GLOUCESTER CITY (Premises of Philadelphia) NJ 08030 (609)456-7887

* TOSHIBA, SEAGATE, MINISCRIBE, TEAC, NEC, TAXAN, MITSUBISHI, TATUNG, GENOA, GOLDSTAR & MITSUMI ARE REGISTERED TRADEMARKS OF THEIR RESPECTIVE COMPANIES

Circle 134 on Reader Service Card (DEALERS: 135)

Table 1: *The results of tests run on an IBM PS/2 Model 80 (16-MHz) and an IBM PC AT Model 339 (8-MHz), transmitting a 20K-byte file using OS2COMM. The transmitting PC had no additional tasks running. Multitasking was performed only on the receiving PC. Note that the communications task actually ran faster in the background (compare tests 6 and 7), since it did not have to place characters on the screen as it was receiving them.*

Test	Transfer rate	Receiving PC	Background tasks	Foreground tasks	Characters dropped	Transmit time (min:sec)
1a	2400	AT	None	Communications	None	1:24
1b	2400	PS/2 80	None	Communications	None	1:24
2a	4800	AT	None	Communications	None	0:42
2b	4800	PS/2 80	None	Communications	None	0:42
3a	9600	AT	None	Communications	None	0:21
3b	9600	PS/2 80	None	Communications	None	0:21
4a	9600	AT	Communications	Compile	None	0;21
4b	9600	PS/2 80	Communications	Compile	None	0:21
5a	9600	AT	Comm. & compile	DOS "TREE"	None	0:21
5b	9600	PS/2 80	Comm. & compile	DOS "TREE"	None	0:21
6a	19200	AT	None	Communications	None	0:17
6b	19200	PS/2 80	None	Communications	None	0:12
7a	19200	AT	Communications	None	None	0:11
7b	19200	PS/2 80	Communications	None	None	0:11
8a	19200	AT	Communications	Compile	None	0:11
8b	19200	PS/2 80	Communications	Compile	None	0:11
9a	19200	AT	Comm. & compile	DOS "TREE"	6	0:11
9b	19200	PS/2 80	Comm. & compile	DOS "TREE"	None	0:11

ms is accurate, then we would expect that 9600 bps would be achievable on an 80286, but that 19,200 would not.

That is exactly what the actual testing showed (see table 1). Overall, I found a number of interesting results.

The tests showed that the PC AT was capable of communicating at up to 9600 bps without losing any data, even with several additional tasks running. Tests at 19,200 bps were successful only when there was no DOS-mode activity on the AT.

This result would indicate that on an 8-MHz 80286, mode switching will cause communications failures at 19,200 bps, but not at 9600 bps and below, which confirms our estimated calculations.

The PS/2 Model 80 handled transfer rates of up to 19,200 without difficulty.

The results of tests 6 and 7 were interesting. In both tests, OS2COMM was the only task running. In test 6, when I ran OS2COMM in the foreground, the receiving system (even on the PS/2) had to use XOFFs to keep the incoming data from overflowing its buffer. In test 7, I ran OS2COMM in the background (with the OS/2 Program Selector displayed on the screen), and data was transferred at the full 19,200-bps bandwidth. The only difference between these tests is that OS/2 had less work to do when OS2COMM was in the background. Since the program did not have to actually display the characters it received, it was able to support the higher transfer rate.

In this regard, it's also interesting to compare tests 6 and 8. In test 6, both receiving systems had to use XON/XOFF processing to avoid losing data. In test 8, however, neither system had to use XON/XOFF, even though there was another major task executing. The difference is that in test 6, the OS2COMM's display and communications threads were both running at high priority and were conflicting with each other. In test 8, the conflicting task was running at a standard priority, and only OS2COMM's communications thread ran at a time-critical priority (the display thread was not needed). As you can see, a communications program must make judicious use of the time-critical threads so that it does not compete with itself for CPU resources.

Note that using transfer rates of 9600 bps and higher on either machine caused the other tasks to come almost to a complete halt. This is the result of running OS2COMM at a time-critical priority.

Sophisticated Software, Design Dilemmas

OS/2 provides all the mechanisms necessary to write excellent serial communications software without requiring that programmers deal directly with the communications hardware. However, along with this sophistication come new design issues, which we have not had to deal with before. Fortunately, OS/2 offers many different techniques to resolve these issues, and the resulting flexibility will allow for the creation of full-featured communications software that no longer has to sneak behind the operating system to get its job done. ■

Editor's note: *The C source code for versions 1.2 and 1.3 of OS2COMM (1.3 provides a plain-ASCII file-transfer capability) is available in a variety of formats. See page 3 for further details.*

Jim Gilliland is manager of systems for the corporate tax department of BP America in Cleveland, Ohio. He can be reached on BIX as "jgilliland."

Here come the Diskaroos.™

KAO
Micro-Floppy Disks From The Surface Scientists
MicroDisk Travel Pack
Diskaroo™
MF2DD
Double Sided
1 MB Capacity
5-color assortment
CERTIFIED 100% FULL WARRANTY
Contains 10 Kao professional quality 3.5" disks in an $11.95 value travel pack.
For IBM® PS/2™ Models 25 and 30, Apple® Macintosh® and other systems requiring 1 MB capacity.

Now the world's finest diskettes are packed to travel.

Whenever diskettes travel, programs and data face added dangers. But snug and secure in their Diskaroo, Kao professional quality MicroDisks are ready to go anywhere.

Diskaroos are rugged, water-resistant, anti-static nylon storage packs, containing ten 1 MB 3.5" Kao MicroDisks in five vibrant colors—the perfect choice for the Macintosh,® IBM® PS/2,™ and most laptop PC's.

And because Kao MicroDisks exceed every industry standard worldwide, you're assured of consistently reliable performance.

Similar packs sell as accessories for up to $11.95. But while supplies last, you can get the Diskaroo containing ten Kao professional quality MicroDisks for the price of other diskette brands in an ordinary box.

Call 1-800-443-0100 ext. 947 now, then see the Diskaroos at your nearest Kao dealer. And don't leap home without one.

KAO®
Media from the Surface Scientists

Macintosh is a registered trademark of Apple Computer, Inc. IBM is a registered trademark and PS/2 a trademark of International Business Machines Corporation. ©1988 Kao Corporation of America.

World Headquarters: **Kao Corporation** 14-10 Nihonbashi Kayabacho 1-chome, Chuo-ku, Tokyo 103 Japan, 813-660-7690 Fax 813-660-7789 Telex KAOTYO J24816
In USA contact: **Kao Corporation of America** Infosystems Division, 2065 Landings Drive, Mountain View, CA 94043 (415) 965-4188 Fax (415) 965-0469
In Canada contact: **Kao-Didak Ltd.** P.O. Box 41, 10 Didak Drive, Arnprior, Ont. K7S 3H2 (613) 623-7901 Fax (613) 623-2886 Telex 0533548
In Europe contact: **Kao Corporation GmbH** Infosystems Division, Wanheimer Str. 57, 4000 Düsseldorf 30, F.R. Germany, 0211-4176-0 Fax 0211-413559 Telex 8587565 kaoe d

Circle 121 on Reader Service Card

HARD DRIVES

Seagate

40Mb ST251

Includes drive, AT mounting hardware & "Disk Manager" partitioning software

$319

Also available for XT

40Mb ST251 PC/XT KIT $369

Includes drive, controller, cables, How-To manual, mounting hardware & partitioning software.

Drives and Kits are available for **All** **PS/2** models!

Card Drive™

Hard Cards

Card Drive 20S 40ms	$319
Card Drive 30S 40ms	$349
Card Drive 50S 40ms	$499

-- Features --

- Available for most Tandy models
- Quality engineered for reliability
- Super easy installation & setup
- ONE YEAR Warranty
- Auto park heads

These Card Drives use quality Seagate Hard Drives

30 Day "Worry-Free" Guarantee

If for any reason , you are not completely satisfied with any product, simply return it for a prompt and courteous refund!

30Mb

Complete PC/XT KIT

Complete PC/XT KIT includes drive, controller, cables, How-To manual & mounting hardware.

$269

Macintosh Drives

Internal drive kits are now available for Macintosh SE and II as well as external kits for Macintosh Plus!

Call for pricing!

Help is just a phone call away with our Technical Assistance Department!

20Mb ST225 KIT

Complete PC/XT KIT includes drive, controller, cables, How-To manual & mounting hardware.

$244

Seagate 150Mb KIT

$788

Complete kit includes drive, cables, Perstor ADRT controller, How-To Manual, mounting hardware and "Disk Manager" partitioning software. Full Height. 28ms access time.

We carry the entire **Seagate** product line including 3.5" drives

65Mb ST277R

40ms access • Half Height
Autoparking heads
This drive requires an RLL controller

$ 379

Includes drive, mounting hardware & "Disk Manager" partitioning software

High Speed 40Mb

Seagate ST251-1
28ms access • Half height • Auto parking heads
Also available for XT

$409

Includes drive, AT mounting hardware & "Disk Manager" partitioning software

No Surcharge for Visa or MasterCard Orders
Hours: 8am to 7pm Monday - Friday, 12pm to 5pm Sat. MST
International Orders call: (602) 784-1038

HARD DRIVES
International
An IDN Company

Toll Free Customer Service: (800) 541-8387

(800) 234-DISK

VISA MasterCard AMERICAN EXPRESS Card

1208 E. Broadway Road #110 • Tempe, AZ 85282
(602) 784-1038 **FAX:** (602) 829-9193

Prices and availability subject to change without notice. All items are NEW with manufacturer's warranty. 5% surcharge for American Express and COD orders. P.O.'s accepted NET 10 - subject to 9% surcharge. Add $10 shipping for APO/FPO orders. 30 Day Guarantee conditions: shipping & handling charge is not refundable; product must be in original condition. BYT1088

Circle 102 on Reader Service Card (DEALERS: 103)

KEEP YOUR PC HEALTHY

A few simple tricks, practiced regularly, can add to your computer's life span

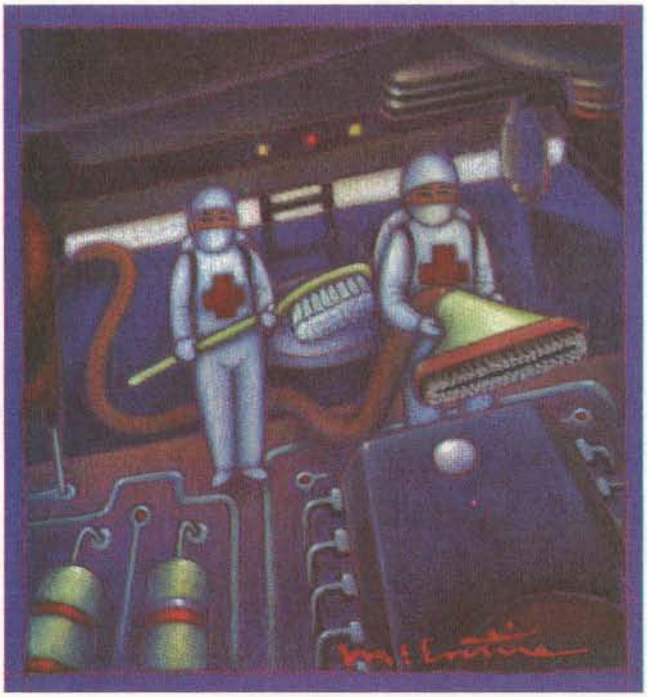
Gene B. Williams

All things age, including your computer system. The older the system, the more likely it is that something is going to go wrong with it. You can't stop the ravages of time, but you can slow them down while also reducing or preventing common problems.

The most common problems, especially with older computers like the IBM PC and XT, are mechanical in nature. A disk drive door might break off; the keys might "clog" or even break; the power switch might wear out; a cable or other wire might break; a contact or even the read/write heads of the floppy disk drive might corrode or become coated with a contaminant.

There is little involved in proper maintenance. Most of it is simple common sense and cleanliness. (For further information, see my book *How to Repair and Maintain Your IBM PC.*)

Preventive Maintenance
Preventing a problem is better than having to fix it after it has happened. This is where cleanliness and proper operating procedures come into play.



All computer systems have three primary enemies: dust and other contaminants; excessive heat and cold; and static electricity, power-line surges, and spikes. These enemies become even more significant as your computer ages.

The key to preventing malfunctions is to eliminate or at least reduce those factors. For example, keep your work area clean. Vacuum or use a slightly damp cloth to remove dust, so it gets picked up and not just moved around. A dry cloth tends to kick the dust into the air, which actually increases the amount of dust that will find its way inside the computer.

Other contaminants should be kept away from the work area. If you smoke, either give it up or take breaks well away from the computer. The tars and smoke particles are virtually guaranteed to eventually gum up everything they shouldn't.

Airflow is critical for proper operation. All the electronic and electrical components in your computer produce heat when in operation. This is particularly true for older PCs that have been packed with expansion boards. These boards require cool air to prevent a deadly heat build-up. Be sure that all cooling vents in the front or sides of the computer are open and that air circulation is good. Check the clearance at the back of the computer; make sure the fan is not blocked by cables or papers. Don't push your computer flush against the wall; leave it some breathing space. Heat can destroy computer chips.

Conversely, cold temperatures can also affect a com-

continued

ILLUSTRATION: LARRY McENTIRE © 1988

puter. Cold can slow down disk drive motors and change the critical positioning of the read/write heads. This can make your computer impossible to boot.

Because all PCs are air-cooled, dust can enter your system through the ventilation slots. At least once a year, take the cover off your computer and vacuum the interior to remove accumulated dust. Use a brush attachment on the vacuum and carefully go over all exposed parts. If you are feeling energetic and have experience with add-in boards, remove all the expansion boards so you have access to the motherboard. You can use a can of compressed air (available at photographic supply stores) to blow out the dust in areas that the vacuum can't reach. Clean or replace all clogged filters.

Power surges, spikes, and static electricity are great "killers" of computers. A standard computer power supply is designed to work reliably with 110 volts of 60 Hz AC. Spikes, sometimes caused by lightning strikes on power lines, or power surges caused by heavy-duty electrical equipment can terminally increase the voltage to your computer and literally fry a power supply or other circuits in the computer. Static electricity, generated by simply walking across a carpeted floor on a dry day, can range up to several thousand volts.

The first line of defense is a commonly available surge suppressor/spike filter. This inexpensive option is available in forms ranging from a simple one-switch power strip to fancy desktop power-control centers.

If you use telecommunications services like BIX, don't ignore your phone lines as a potential source of trouble. Phone-line surge suppressors are available that will prevent your modem from "taking a hit" due to surges on the phone lines. Another solution is to invest in an uninterruptible power supply. The UPS will isolate your computer from most of the trouble on the power lines and, in case of a power failure, give you time to shut down your computer without losing data. However, even a surge suppressor or a UPS can have its problems. (See Mark Waller's two-part series on PC power in the October and November issues of BYTE.)

Static electricity problems can be eliminated by using antistatic sprays on carpeting, by placing antistatic mats underneath your chair, or with a desktop antistatic mat beneath your keyboard.

Disk Drives

Because floppy disk drives are largely mechanical devices, they are prone to a variety of malfunctions. They are also critical in the overall function of a computer system—especially if your system doesn't have a hard disk drive.

On many older, full-height floppy disk drives, the drive door and hinge assembly are made of plastic. This assembly is held in place by two screws, which do a fine job of holding it in place but create another weak spot.

To prevent breaking the door or hinge, use your thumb and finger. The idea is to get the thumb pushing inward to prevent the door from snapping open. The too-common practice of flipping the door from the bottom is a sure way to break the door.

A sneakier situation is when one side of the hinge is cracked. The door will seem to operate, but the spindle inside the drive won't be able to clamp properly. You'll get nothing but read/write errors. Replace the door assembly.

Fortunately, replacing the drive door assembly on full-height drives is easy (once you locate a new door assembly). Remove the computer case, and you'll have easy access to the two screws that hold the door in place. To realign the new door (or to realign one that has slipped), simply make sure that the front of the door, when closed, is flush with the front of the drive.

Cleaning the drive heads is still a matter of controversy. Some people say they should be cleaned on a regular basis, while others swear that it's not only unnecessary but damaging. However, if the choice is between cleaning the heads or having to replace the drive, you have nothing to lose.

Hard disk drives require little maintenance because they are sealed units. The best procedure is to back up your files onto floppy disks at regular intervals.

In everyday operation, DOS stores files in any available sector on the hard disk. Eventually, all your files are fragmented into sectors all over your hard disk. DOS has to search all over the hard disk, switching from track to track and sector to sector, in order to access a large file or program.

To renew hard disk performance, you can use a defragger program, like the Disk Optimizer from Solution Systems or the Speed Disk program that is part of

continued

WE SPEAK VIDEO™

Call Avocado Computer for

S-VHS encoders
remote monitors
extension cables
genlock and overlay
analog RGB conversion
specialty display cards
composite color decoders
flickerless video production
NTSC composite color encoders
custom & modified display cards
multiple output video amplifiers
scientific & industrial applications

AVOCADO

17352 YORKSHIRE AVENUE
YORBA LINDA, CALIFORNIA 92686
(714) 528-1025

Circle 20 on Reader Service Card

Our Printer Sharing Unit Does Networking!

An Integrated Solution

Take our **Master Switch™**, a sophisticated sharing device, combine it with **MasterNet™** networking software for PCs, and you've got an integrated solution for printer and plotter sharing, file transfer, electronic mail, and a lot more. Of course you can also share modems, minis, and mainframes or access the network remotely. Installation and operation is very simple.

Versatile

Or you can use the Master Switch to link any computer or peripheral with a serial or parallel interface. The switch accepts over 20 commands for controlling the flow of data. It may be operated automatically, by command, or with interactive menus. Its buffer is expandable to one megabyte and holds up to 64 simultaneous jobs. The **MasterLink™** utility diskette for PCs comes with every unit and unleashes the power of the switch with its memory-resident access to the commands and menus.

Other Products

We have a full line of connectivity solutions. If you just want printer sharing, we've got it. We also have automatic switches, code-activated switches, buffers, converters, cables, protocol converters, multiplexers, line drivers, and other products.

Commitment to Excellence

At Rose Electronics, we're not satisfied until you're satisfied. That's why we have thousands of customers around the world including large, medium, and small businesses, factories, stores, educational institutions, and Federal, state, and local governments. We back our products with full technical support, a one-year warranty, and a thirty-day money-back guarantee.

ROSE ELECTRONICS

Call now for literature or more information. (800) 333-9343

Give a Rose to your computer

P.O. Box 742571 • Houston, Texas 77274 • **Tel** (713) 933-7673 • **FAX** (713) 933-0044 • **Telex** 4948886

Table 1: *Common IBM POST audible error codes and screen codes for the IBM PC.*

POST error responses

Indication	**Problem**
Nothing happens	Power
Continuous beep	Power
Repeating short beeps	Power
1 long, 1 short	System board
1 long, 2 short	Monitor
1 short, no display	Monitor
1 short, BASIC on-screen	Disk drive

Common code errors

Code	**Problem**
101, 131	System board
201, xxxx201	Memory
Parity Check x	Power
301, xx301	Keyboard
601	Floppy disk drive
1701	Hard disk drive

Table 2: *The POST diagnostics error code will identify which RAM chip has failed. The error code will be xxxx201, with the first two x's indicating the bank and the second two x's indicating the bit chip. For example, a RAM error code of 0C40 would mean that the bit 6 chip on bank 3 has failed. A code of 0220 would mean that the bit 5 chip on bank 2 needs to be replaced.*

IBM system board RAM error codes

The first two digits indicate the bank.

	Older: 16K to 64K	**Newer: 64K to 256K**
Bank 0	00	00
Bank 1	01	04
Bank 2	02	08
Bank 3	03	0C

The last two digits indicate the bit chip.

Parity bit	00	Bit 4	10
Bit 0	01	Bit 5	20
Bit 1	02	Bit 6	40
Bit 2	04	Bit 7	80
Bit 3	08		

The Norton Utilities Advanced Edition. A defragger speeds up disk operation by rearranging files into contiguous sectors. This reduces the time DOS requires to access your files and can reduce wear and tear on the drive.

Because hard disks are critically important in most computer systems, you may want to invest in the SpinRite package from Gibson Research. SpinRite performs an analysis on a hard disk and can do a low-level, nondestructive reformat of the disk if it detects any problems. It is useful in correcting hard disk problems before they become serious.

Basic Troubleshooting

You don't need a degree in engineering to diagnose and repair the most common malfunctions. Troubleshooting is nothing more than a process of elimination. The problem can be in just so many places. Find out where it's not, and you'll know where it is. Always begin with the simplest and most obvious source of the problem. For example, if your computer is completely dead, start with the AC power outlet. If you're getting read/write errors from the disk drive, begin by examining the drive door. Don't forget the disk.

Symptoms the computer exhibits will help you in the elimination process. For example, if the computer seems to be functioning but the monitor is dead, there's no need to test the disk drives. You should first check the power light on the monitor to see that it's getting power. If the monitor is powered up, the problem is isolated to one of three places: the monitor circuitry, the video cable, or the video board in the computer. You can test the cable with an ohmmeter to see if any wires are broken or short-circuited. You can test the monitor and video board by substituting another component that you know is good. If the problem goes away after the substitution, you've isolated the defective component.

You already have a tool that will help you diagnose your computer: the built-in power-on self-test your computer performs every time you turn it on. This POST puts the computer through a quick "once-over." The test covers the system board, RAM, video board, keyboard, and floppy disk and hard disk drives. If an error occurs, the computer should respond with audible signals and error codes on the screen. Error codes vary on different computers. Common codes for the IBM PC are shown in table 1.

The POST diagnostics will tell you, for example, which RAM chip has failed (see table 2). The error code will be xxxx201, with the x's being digits. The first two indicate the bank; the second two indicate the bit chip. (The 201 is the code for RAM problems.) The RAM chips are highly sensitive to static electricity and transient voltages, and they can become more sensitive with age (especially if the computer has overheated).

You can do a more thorough check by using the diagnostics program or disk sold with most computers. This performs a more thorough test of every system, including a read/write test of the floppy disk and hard disk drives (see table 3). An even more exhaustive set of tests is available in the IBM Advanced Diagnostics disk or the Disk Technician package from Prime Solutions. These programs will generate detailed reports to indicate the source of the trouble.

The fastest way of checking suspected circuit boards and components is by substitution with a good one. If the substituted part works in your computer system, you have isolated the bad part. You

continued

Receive a FREE* SIVA 386 SYSTEM

with the purchase of $2995++ of software or $4995++ of hardware.

Standard 386 Features:

- 32-bit Intel 80386-16 CPU.
- 1MB of 32-bit RAM on board. System expandable to 16MB.
- 8/16/20 MHz Keyboard selectable.
- ST-251-1 Seagate 40MB Formatted 28 ms high speed, with ultra high speed Controller 1:1 interleave.
- 1.2MB High Capacity Floppy Drive.
- Super deluxe heavy duty tower case with 6 half-height drive openings.
- High-resolution 12″ Non-Glare Amber Display. Tilt and Swivel base, Hercules-compatible Adapter.
- 101 Key Enhanced Keyboard, Pleasant "Tactile/Click" Feel.
- 80287/387 Math-Coprocessors optional.
- Fully compatible with virtually all XT/AT and 386 software.

Upgrades for your FREE 386 System:

- VGA Color Upgrade — add only $495.
- 20 MHz CPU Upgrade — add only $195.
- Call for all other options and upgrades.

Choose Your Hardware

A hardware purchase of $4995 or more is required to receive the SIVA 386 System FREE.

• QMS PS 800II Postscript Laser Printer	$5995
• QMS PS 810 Postscript Laser Printer	$4995
• CDC WREN IV 300MB SCSI Hard drive with Controller	$2595
• CDC WREN III 155MB SCSI Hard drive with Controller	$1795
• CDC WREN II 86MB ST506 Hard drive with HD/FD Controller	$ 895
• Eight Port RS232 Intelligent Card with Xenix Driver	$ 995
• 32-Bit 8MB Memory Expansion Board	$2997
• Intel 80387 — 16 Coprocessor	$ 495

Software

• Complete SCO Xenix System (including Operating System, Developing System and Text Processing System for 80386-based System)	$1595
• SCO Lyrix System	$ 595
• SCO Professional	$ 895
• SCO Integra	$1295
• SCO Foxbase Plus	$ 995
• SCO VP/IX (integrated DOS environment — two users)	$ 495
• Language & Development Tools	CALL
• Networking & Communication Packages	CALL

A software purchase of $2995 or more is required to receive your FREE SIVA 386 System. Mix and match to meet your needs!

Prices are for Industry Standard 80386-based Computers. For all other systems and items please call:

1-800-252-4212

VNS America Corp.

Suite 270, 910 Boston Post Road
Marlboro, Massachusetts 01752 U.S.A.
In Massachusetts 508-460-0016
FAX: 508-481-2218

*Offer good until December 31, 1988.

Circle 247 on Reader Service Card

• SCO is a trademark of The Santa Cruz Operation, Inc. • XENIX is a registered trademark of Microsoft Corporation. • VP/ix is a trademark of INTERACTIVE Systems Corporation.
• PS/2, XT and AT are trademarks of IBM Corporation. Prices are subject to change without notice. Call for complete warranty details.

Circle 154 on Reader Service Card

IEEE-488...

Solutions for Your Personal Computer

PC/XT/AT, 386, and PS/2

UNEQUALED BENEFITS:

NI-488 Software

- Use your favorite programming language: BASICA, GWBASIC, QuickBASIC, Better BASIC, True BASIC, Compiled BASIC, TURBO BASIC, Microsoft C, TURBO C, Lattice C, C86/C86+, Aztec C, TURBO Pascal, Microsoft Pascal, Microsoft FORTRAN, Professional FORTRAN, Assembler
- Easy-to-use high level NI-488 functions as well as Hewlett-Packard Style calls
- Automatic error presentation window
- ON SRQ subroutine branching
- Serial/Parallel port redirection to GPIB
- Interactive instrument control utility
- Interactive GPIB configuration utility

Hardware

- Low cost/high performance choices
- Highest performance available (1M bytes/sec) using NI Turbo488™ ASIC
- Converters, Controllers, Extenders, Expander, Analyzer, Tester and Buffer
- Widest application software support: LabWindows, Lotus Measure, ASYST, ASYSTANT GPIB, TBASIC, LABTECH NOTEBOOK, GURU, EZ-TEK, EZ TEST, SPD, WaveTest, TestWindows, DADiSP
- FCC Class B certified

- Free Comprehensive Customer Support
- Training
- 2 year warranty
- 30 day money back guarantee

Call for Free Catalog
(800)531-4742 • (512)250-9119

NATIONAL INSTRUMENTS®
The Software is the Instrument™

12109 Technology Blvd.
Austin, Texas 78727-6204
Japan 81 (03) 788-1921 • France (1) 48 65 33 70
United Kingdom 44-01-549-3444 • West Germany 49 89 807 081
Italy 39-2-98491071-2-3 • The Netherlands 31 070-996360

Table 3: *This is a list of IBM diagnostics disk error codes. If the last two digits are 0, the system is operating correctly.*

IBM diagnostics disk error codes

Code	Problem
02x	Power
1xx	System board
20x, xxxx, xx20x	Memory
30x, xx30x	Keyboard
4xx	Monochrome monitor
5xx	Color monitor
6xx	Floppy disk drive
7xx	8087 coprocessor
9xx	Printer adapter
11xx, 12xx	Async communications
13xx	Game adapter
14xx	Printer
15xx	SDLC communications adapter
17xx	Hard disk drive
18xx	Expansion unit

can also test the suspected bad part in another system to verify that it is defective.

If It's Dead

It's relatively rare for a computer to fail completely. If this does happen, the problem is almost certain to be in one of two places. Either the wall outlet is dead, or the power supply has failed. As always, begin with the easiest. Check the outlet to be sure it's supplying power. (You can eliminate the outlet immediately if the cooling fan is operating.)

Then, you can use a volt ohmmeter to perform a number of simple tests. A cable can be eliminated as the possible cause of trouble by using the VOM to check for continuity. You can also use it to probe for the presence of voltage. A suspected power supply can be checked easily for DC voltage output in the 5-V and 12-V ranges at the four pins bringing power to the floppy disk drives. The location of the pins can vary depending on the type of drive you have. On older PCs, these are located at the left rear of the drive, with the pin closest to the edge being pin 1. The two pins in the center are ground. If you find 11.5 to 12.6 V DC between pins 1 and 3, and 4.8 to 5.2 V DC between pins 2 and 4, the power supply is probably doing its job, and something else is wrong.

Other Troubleshooting

Even while sitting in their slots and sockets, the components in your computer are subject to the ubiquitous effects of corrosion and oxidation. Even gold-plated contacts are no guarantee against oxidation. The chips themselves have a tendency to creep out of their sockets due to thermal expansion and contraction.

A simple troubleshooting method is what I call the "laying on of hands" technique. This involves simply opening up your computer, pressing down on every socketed chip, and gently pulling apart and reseating every cable connection. This will displace any oxidized metal and reestablish a good electrical connection. Removing and reseating expansion boards is also wise. A surprising number of sick or dead computers spring back to health after this treatment.

For persistent or recurring oxidation problems, you can use Cramolin R2 spray. This is an antioxidizing lubricant that cleans metal surfaces and forms a protective layer to maintain electrical conductivity. It is useful for parallel, serial, and expansion board connections. (Cramolin R2 is available from Craig Laboratories, Inc., 1175-O Industrial Ave., P.O. Box J, Escondido, CA 92025, (619) 743-7143.)

If Pain Persists

Sometimes, despite every diagnostic technique, the cause of a problem may still elude you. That's the time to call in the professional computer repair technician. After going through all the maintenance tests and procedures, you'll be able to tell the technician where the problem is not located.

But if you follow these simple maintenance procedures, your PC can live a long and productive life rather than die an early death due to neglect. ■

Gene B. Williams is an Arizona-based author. He can be reached on BIX c/o "editors."

COMPUTER DISCOUNT WAREHOUSE™

NEC

NEC Multispeed	$1348.64
NEC Multispeed EL	1499.76
NEC Multispeed HD w/20 Meg	2365.77
NEC Powermate 2, 40 Meg	NEW
NEC Powermate 2, 66 Meg	LOWER
NEC Powermate 386, 66 Meg	NEC
NEC Powermate 386, 130 Meg	PRICES

AT&T *The right choice*

6300 WGS	$1099.42
6312 WGS	1692.12
6386 WGS	3187.78
Model 63	4995.85
Model 64	5880.70
Model 75	6920.35

All WGS Models Come with Keyboard

WHY PAY RETAIL?

Nobody Sells For Less

CALL FOR LOWEST CUSTOM QUOTES

TOSHIBA

3100 w/20 Meg	$2998.50
1000	779.41
1200	2237.55
1200, 2 Floppy	1612.35
3200	SPECIAL BUY
5100	NEW MODEL

PC MAGAZINE Award of Excellence

SAMSUNG

S-300 4/8 MHz, 512K, 6 Slots S/P/C, Monographics board, DOS, Keyboard

S-300, 1 Floppy	$749.50
S-300, 20 Meg	989.95
S-300, 40 Meg	1117.82

S-500 AT Compatible 8/10 MHz, 8 Slots, S/P/C, Monographics Board, DOS, Keyboard

S-500, 1.2M Floppy	$1095.45
S-500, 20 Meg	1469.80
S-500, 40 Meg	1624.45

HARDWARE, SOFTWARE & PERIPHERALS AT *DISCOUNT* PRICES

COMPUTERS

AST

MDL 70	$1335.20	MDL 170	$2998.36
MDL 80	1639.70	MDL 300	3490.40
MDL 90	1936.15	MDL 340	3945.65
MDL 120	2280.05	MDL 390	5589.40
MDL 140	2649.55		

IBM PS2

MDL 30, 2 dr	$1272.20	MDL 50Z, 30 Meg	$2943.60
MDL 30, 20 Meg	1725.17	MDL 50Z, 60 Meg	NEW
MDL 60, 40 Meg	3340.15	MDL 70, All Mdls.	PS2s
MDL 60, 70 Meg	3567.50	MDL 80, 40 Meg	4497.67
MDL 80, 111 Meg	5995.80	MDL 80, 70 Meg	5330.30

COMPAQ™

286, Model 1	$1868.55	386, Model 300	$8995.20
286, 40 Meg	2495.20	Port. II, Mdl 2	1896.10
286, 70 Meg	2798.20	Port. II, Mdl 4	2797.00
386, Model 60	5485.30	Port. III, Mdl 20	3495.85
386, Model 130	6945.92	Port. III, Mdl 40	4095.35
386S, Model 20	SAVE	Port. 386 Mdl 40	5426.24
386S, Model 40	3762.20	Port. 386 Mdl 100	6689.74

TOSHIBA

T3100, 20 Meg	$2998.50	T1200	$2237.55
T3200	3689.65	T1200, 2 Floppy	1612.35
T1000	779.41	T5100	4767.62

PACKARD BELL

PB88 (XT Turbo)	$645.64
PB88 w/1 floppy, 20 Meg	956.80
VT286, 10 MHz	1249.36
VT286, 12 MHz	1349.36
VT286 w/20 Meg	1573.50
VT286 w/40 Meg	1724.10
VT386	NEW MODEL

WYSE

MDL 2108	$1170.50	MDL 2214	$1978.30
MDL 2112	1739.20	MDL 3216	2749.05

ZENITH data systems

Supersport Model 2	ALL ZENITH
Supersport Model 20	MODELS
Supersport 286 Model 20	IN STOCK

Other Computers Available Upon Request

DRIVES, TAPES & HARDCARDS

FLOPPIES, DRIVES & TAPES

1/2 height floppy drive	$99.00
MINISCRIBE 20 Meg 1/2 height w/cont.	329.14
MINISCRIBE 30 Meg 1/2 height w/RLL	345.95
SEAGATE 20 Meg 1/2 height hard drive	289.69
SEAGATE 30 Meg 1/2 height w/RLL	309.72
SEAGATE 40 Meg 1/2 height	399.50
GENOA 60 Meg int. tape/ ext. tape	734.60 / 895.10
GENOA 150 Meg int. tape	1078.85
IOMEGA 20+20 External 5¼	1795.73
IRWIN 20 M/ 40 M Internal Tape	399.10 / 539.20
MINISCRIBE 40 Meg 28ms	619.40
MINISCRIBE 80 Meg 28ms	795.45
MOUNTAIN 4440 int./ ext.	385.80 / 557.75
PLUS Passport 20	479.10
PLUS Passport 40	599.88
PLUS 20 & 40 System Kit	489.75
PLUS PS2 MC System Kit	585.58
PRIAM 40 Meg/ 60 Meg	669.55 / 749.95
PRIAM 130 Meg hard disk	1510.40
SEAGATE 30 Meg/ 40 Meg	479.80 / 558.98
SEAGATE 4096 80 Meg hard disk	645.10

HARDCARDS

PLUS DEVELOPMENT 20 Meg	$569.55
PLUS DEVELOPMENT 40 Meg	749.80
WESTERN DIGITAL 30 Meg	416.30

PRINTERS

EPSON

DFX5000	CALL	LX800	ALL
EX800	CDW™	LQ500	EPSON
FX86e	FOR	LQ850	MODELS
FX286e	BEST	LQ950	READY
FX850	PRICE	LQ1050	TO
FX1050	EVER	LQ2550	SHIP

DICONIX by Kodak

150P/300	$319.17/479.17

IBM

Pro Printer II	$429.95	Quietwriter III	$1295.62

NEC

P560XL	$914.75	5200	$532.25
P2200	369.65	5300	696.47
3550	744.12	8850	1080.75
P960XL	1067.70	CALL FOR ACCESSORIES	

OKIDATA

ML 182S	$279.76	ML 320	$346.63
ML 182P	232.50	ML 321	479.28
LASERLINE 6	1286.69	ML 390	475.96
ML 292 Plus	377.44	ML 391	648.48
ML 293 Plus	516.55	ML 393	949.55
ML 294	737.10	ML 393 Color	1057.60

PANASONIC

1080I	$179.60	1091I	$219.85
1092i	334.28	1592	433.44
1595	459.45	3131	299.32
3151	446.52	1524	579.10

CITIZEN

120D	$199.55	MSP55	$579.66
MSP50	423.64	Premiere 35	577.17

TOSHIBA

P321SL	$494.85	P351-2 Color	$1199.95
P341SL	634.17	P351SX	1019.45

LASER PRINTERS

H-P Laser Jet Model 2	$1699.40
AST Turbolaser P/S	IN STOCK
H-P Deskjet	689.00
NEC LC860/ LC890	1982.44 / 3295.60
PANASONIC Laser	1599.35
TOSHIBA PageLaser	2530.20

CHIPS

8087-2/ 8087-3	$159.33 / 122.50
80287-6/ -8/ -10	174.30 / 289.55 / 329.25
80387-16/ 80387-20	445.68 / 728.44

PLOTTERS, DIGITIZERS & SCANNERS

CALCOMP

1023	$3838.38	1043	$6477.15
1042	7539.95	1044	10,305.06

ROLAND

DXY-885	$1149.79	DPX-2000	$3464.12
DXY-990	1457.82	DPX-3300	4689.52

SUMMASKETCH

12x12	$376.30	12x18	$632.50

HEWLETT PACKARD

HP7440A	$968.30
HP7475A	1417.44
HP7550	2926.56
HP7570	LOWEST PRICE
HP SCANJET	SAVE

HOUSTON INSTRUMENTS

HI DMP-42
HI DMP-52/52MP
HI DMP-56A
HI DMP-61/62

FAX MACHINES & PAPER SHREDDERS

SHARP FO-300	$1199.10	TOSHIBA 3010	$1314.44
SHARP FO-420	1399.95	GBC-1656	1459.80
SHARP FO-500	1599.95	GBC-1236S	915.44

NOVELL NETWORKING

SANTA CLARA Diskless Workstation	$640.40

SOFTWARE & STARTER KITS

WESTERN DIGITAL 3 Node LAN kit w/Western Digital software	$720.34
Entry-level 286 Starter Kit, 4 Users	489.90
Entry-level 286 Starter Kit, 8 Users	SAVE
NOVELL 286 Software V. 2.11	1676.34
NOVELL SFT Netware Level I	2148.66
NOVELL SFT Netware Level II V2.1	2757.60

INTERFACE CARDS

ARCNET PC110 LANboard PS2	$539.40
ARCNET PC110 LANBoard	188.27
ARCNET PC210 LANBoard	235.50
ETHERNET Interface Connector	329.80
ETHERNET Plus Board (for 286)	698.74
G-NET Interface Card w/cable	296.52
WESTERN DIGITAL Ethernet Cards	269.10

ACCESSORIES

ARCNET Passive Hub	$79.00
ARCNET Active Hub	427.98
Ethernet Terminators	39.50
Novell Keycard 2.11	78.40

Novell trained and authorized sales and support.
Call CDW for all new Software versions.

MODEMS & COMMUNICATIONS

AST 5251-11 Plus	$619.04
EVEREX 1200B/ 2400B	109.90 / 199.50
IRMA 3278/79	695.17
PACKARD BELL 2400 Int/ 2400 Ext	169.95 / 199.22

Hayes

HAYES 1200	$289.60	2400B	$379.65
1200B	269.20	2400PS2	399.15
2400	424.68		

USRobotics

1200B	$108.45	2400B	$199.70
1200 External	129.10	9600 HST	665.20

Ven-Tel

1200 Int.	$194.50	2400 Int.	$299.10
1200 Plus	228.88	2400 Ext.	389.44

BATTERY BACKUP & SURGE

PERMA POWER 6 Outlet Surge Supp.	$29.40

TRIPPLITE

BC-450	$419.78	4 outlet	$ 44.25
BC-1200	765.55	LC-1200	159.85
BC-2000	1179.80	LC-1800	189.85

DATASHIELD

500 Watt	$560.05	1200 Watt	$994.75
800 Watt	638.50	6 Outlet Surge	27.85

MISC. & ACCESSORIES

A-B Switching Box (par. or serial)	$44.95
BASF 5 Pack of 10 DS/DD w/case	49.00
KENSINGTON Masterpiece	99.99
KENSINGTON Masterpiece Plus	123.40
KEYTRONICS 5151 IBM or AT&T	154.95
KEYTRONICS 101	107.65
Printer Cable (IBM to Centronics) 6 ft.	19.99
XT Power Supply 150 Watt	69.95

MONITOR INTERFACE CARDS

CDW™ color card	$ 99.00
CDW™ monographics card w/p	99.00
GENOA Spectrum (color monographic w/p)	168.75
HERCULES color card w/p	146.16
HERCULES monographics plus w/p	179.84
TAXAN MONOGRAPHIC w/p	99.00

MONOCHROME MONITORS

AT&T Monochrome Monitor	$189.40
AMDEK 310A/ 410A	119.99 / 149.99
AMDEK 1280	679.78
COMPAQ monochrome monitor	194.46
COMPAQ VGA Mono	193.10
IBM PS2 8503	209.95
NEC Multisync GS	194.52
NEC Monograph	1297.25
PGS MAX 12E	139.40
PACKARD BELL Green or Amber	89.95
TAXAN 123 Green/ 124 Amber	119.50 / 124.05

COLOR GRAPHIC MONITORS

AMDEK color 600T/ 722	$349.24 / 444.49
IBM PS2 8512 Color	438.40
IBM PS2 8513 Enhanced Color	519.20
SAMSUNG RGB Comp	248.60
PGS HX-12 Plus	417.15
TAXAN 650/ 720	469.90 / 299.80
MAGNAVOX 8762	259.05

VGA & EGA PRODUCTS

VGA & EGA MONITORS

COMPAQ VGA monitor	$548.68
MAGNAVOX 943EGA	387.40
MITSUBISHI Diamond Scan	522.20
NEC Multisync II/ PLUS	609.76 / 888.10
NEC Multisync XL 19 inch	1974.46
PACKARD BELL VGA Monitor	389.95
PGS Ultrasync	515.33
SONY Multiscan 1303/ 1302	599.45/ 649.25
TAXAN 770 PLUS	499.40
ZENITH Z-1490	699.31

VGA DISPLAY CARDS

ATI VGA VIP	$289.24
GENOA 5100/ 5200	234.34 / 330.55
PARADISE VGA	297.68
ORCHID VGA	278.14
VIDEO-7 VGA	299.15

EGA DISPLAY CARDS

ATI Wonder Card	$199.95
GENOA Super EGA Hi-Res 800 x 600	234.40
NEC MVA 1024	960.50
NEC GB-1 640x480	229.43
PARADISE Auto Switch EGA 480	179.65
VIDEO 7 Vega Deluxe	249.74

CAD MONITORS & CARDS

MITSUBISHI 6905, 19 inch	$2375.96
MITSUBISHI 6922, 19 inch	1974.60
HITACHI 4119, 19 inch	2310.65
CONTROL SYSTEMS ARTIST 1016	1779.20
VERMONT Cobra	1977.75
METHEUS 1104	948.65

MICE

LOGITECH HIRez	$99.95
LOGITECH C7/ Bus	89.95 / 109.06
LOGITECH Logimouse C7 w/publisher	124.85
MICROSOFT Mouse (Bus Version)	109.34
MICROSOFT Mouse (Serial Version)	117.25
MOUSE SYSTEMS (Serial Version)	99.55
MOUSE SYSTEMS (Bus Version)	108.77
MOUSE SYSTEMS Omnimouse	59.70

MOST ORDERS SHIPPED WITHIN 48 HOURS.

HIGH VOLUME BIDS INVITED

730 Anthony Trail, Northbrook, IL 60062 FAX-A-BID (312) 291-1737

If you find a better price call us before you buy.

WHY WAIT? CALL COMPUTER DISCOUNT WAREHOUSE™ NOW!

WORDPERFECT 5.0 5¼/3¼	$219.90/228.90
dBase III + 5¼/3½	399.00/424.00
LOTUS 1-2-3 5¼/3½	305.00/327.00
Paradox Version 2.0	424.00
Ventura Software Version 1.1	499.00
MICROSOFT Word V.4/Excell	243.50/319.30

Open terms available to approved credit

(800) 233-4426

In Illinois
(312) 498-1426

FAX
(312) 291-1737

Credit card charges are not submitted until time of shipment.

MasterCard VISA AMERICAN EXPRESS Card

CHARTER MEMBER
MMC
MICROCOMPUTER MARKETING COUNCIL
of the Direct Marketing Association, Inc.
MEMBER dma E1018

Credit Card charges are not submitted until time of shipment. Shipping and handling additional. On all hard drive orders and orders under $200.00 please add $5.00 handling fee. Non-defective returns subject to restocking fee. All prices reflect 3% discount for cash. Allow 10 business days for shipping when paying by personal check. Software, chips and other electronic components are not returnable. All pricing subject to change. TM - Registered trademarks of IBM and COMPAQ.

NEW MENUING INTERFACE AND RELIABILITY PROCEDURE

GET SERIOUS

...ABOUT ANALYZING YOUR DATA.

You might be spreading your spreadsheet a little too thin. Or maybe you're starting from scratch. But if you're serious about data analysis, you're ready for SPSS/PC+™ – a full software family that brings you eight high-powered ways to complete any data analysis task.

Enter it. SPSS Data Entry II™ is a fully integrated data entry, cleaning and editing tool.

Analyze it. The SPSS/PC+ base package provides a powerful array of statistical and reporting procedures.

Picture it. SPSS/PC+ Graph-in-the-Box™ featuring New England Software's Graph-in-the-Box™ offers full color "snapshot" graphics.

Examine it. SPSS/PC+ Advanced Statistics™ lets you get more serious with your data.

Predict it. SPSS/PC+ Trends™ – our latest option – is the complete time series analysis/forecasting tool.

Table it. SPSS/PC+ Tables™ produces presentation-ready tables instantly.

Chart it. SPSS/PC+ Graphics™ featuring Microsoft® Chart creates show-stopping graphs and charts.

Map it. SPSS/PC+ Mapping™ featuring MAP-MASTER™ creates maps where vast amounts of data can be summarized and presented in one, simple picture.

SPSS/PC+ products are being put to productive use by serious fact finders in business, government and education. For countless purposes such as market research. Wage and salary studies. Survey analysis. And quality control. Plus each product is superbly documented and supported by SPSS Inc., a leader in statistical software for nearly 20 years. While specially tailored customer support is available through the VALUE PLUS™ plan. And SPSS now offers a SPSS/PC+ version for Novell LANs.

So if you're serious about data analysis, step up to SPSS/PC+. For details, contact our Marketing Department. **CALL 1/312/329-3315**

SPSS inc.

SPSS Inc. • 444 North Michigan Avenue, Suite 3000 • Chicago, Illinois 60611
In Europe: SPSS Europe B.V. • P.O. Box 115 • 4200 AC Gorinchem, The Netherlands • Telephone: +31183036711 • TWX: 21019

SPSS/PC+ runs on IBM PC/XT/AT's with hard disk. Contact SPSS Inc. for compatible microcomputers. SPSS/PC+, SPSS Data Entry II, SPSS/PC+ Graph-in-the-Box, SPSS/PC+ Advanced Statistics, SPSS/PC+ Trends, SPSS/PC+ Tables, SPSS/PC+ Graphics and SPSS/PC+ Mapping are trademarks of SPSS Inc. VALUE PLUS is a trademark of SPSS Inc. Chart and Microsoft are trademarks of Microsoft Corporation. MAP-MASTER is a trademark of Ashton-Tate. Graph-in-the-Box is a trademark of New England Software, Inc.

© 1987, SPSS Inc.

WRITING OS/2 GRAPHICS PROGRAMS

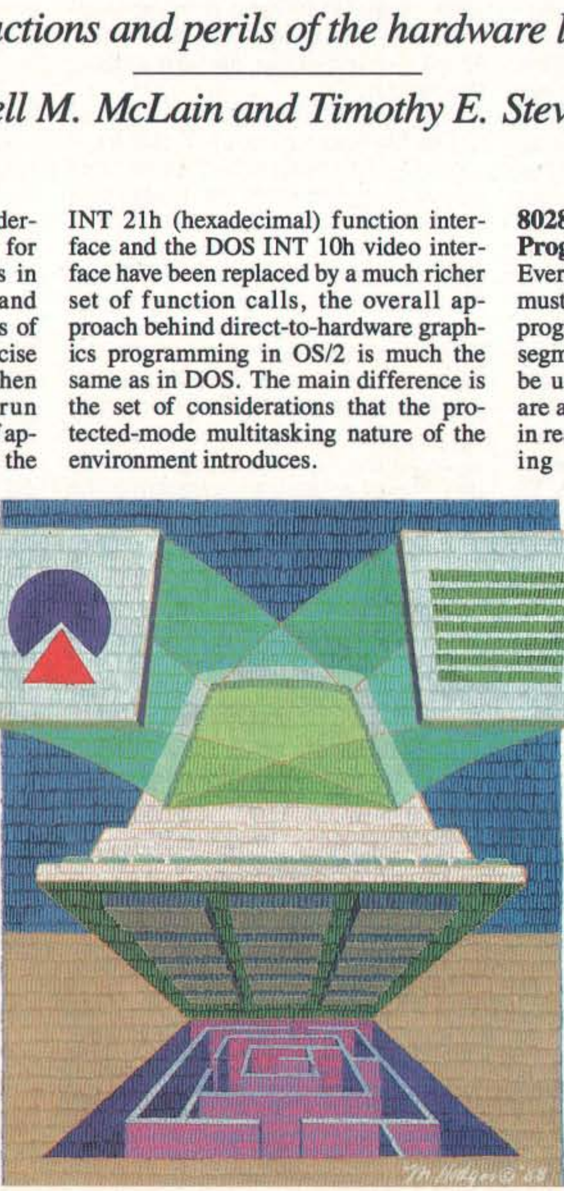
The attractions and perils of the hardware labyrinth

Mitchell M. McLain and Timothy E. Stevenson

Most programmers understand the necessity for high-quality graphics in their applications, and the advanced features of OS/2 make the need for clear, precise graphics displays even greater. When writing graphics applications to run under OS/2, you can take a number of approaches, from writing directly to the hardware, to using a standard windowing environment, to using device-independent graphics drivers.

Writing OS/2 graphics applications directly to the display hardware involves a number of challenges, and it requires that you understand some OS/2-specific programming issues, such as 80286 protected-mode programming rules; OS/2 privilege levels; OS/2 multitasking features; specific implications of multitasking for graphics programming; supporting mouse devices; and National Language Support.

It is important to realize that OS/2 *does* allow graphics programmers to address display hardware directly. Just as in DOS, you can obtain a pointer to the display buffer and program the adapter's registers. Although the DOS INT 21h (hexadecimal) function interface and the DOS INT 10h video interface have been replaced by a much richer set of function calls, the overall approach behind direct-to-hardware graphics programming in OS/2 is much the same as in DOS. The main difference is the set of considerations that the protected-mode multitasking nature of the environment introduces.



80286 Protected-Mode Programming Rules

Every protected-mode program in OS/2 must adhere to 80286 protected-mode programming rules. The first rule is that segment registers (ES, DS, and SS) can be used only for valid selectors (which are analogous to segment base addresses in real-mode DOS programming). Loading any one of these registers with something that is not a valid selector initiates a General Protection Fault (GPF), and your program will be aborted. The practical result of this rule is that segment registers cannot be used as scratch pads, as they can in DOS.

The second protected-mode programming rule is that your program cannot access memory that it doesn't own (as DOS programs can) unless the owner gives permission. In addition, memory segments have defined upper and lower bounds. Thus, it can no longer be assumed that every segment will be 64K bytes in size. Each segment's upper limit is defined when it is created (the lower limit being 0). Addressing beyond either of these limits will cause your program to abort with a GPF. This feature

continued

ILLUSTRATION: MIKE HODGES © 1988

might seem like a limitation at first, but you will begin to appreciate it when you discover how well it enables you to find errant pointer bugs.

OS/2 Privilege Levels

In addition to 80286 hardware considerations, direct-to-hardware graphics programmers must be aware of some rules that OS/2 itself imposes. These rules stem from the fact that the 80286 protected-mode architecture lets OS/2 partition its running environment into four rings of privilege levels (see figure 1).

The operating system employs privilege levels 3, 2, and 0 (0 being the highest level). Most of the code you write will run at privilege level 3 (PL3). This level provides access to all system services, such as memory management, file I/O, keyboard and mouse input, and text-mode video I/O. You can read from and write to the display buffer at PL3, but the code that programs the video hardware registers must run at PL2.

The 80286 hardware lets the operating system specify the privilege level at which access to hardware registers will be permitted. OS/2 restricts this access to PL2, although very early prerelease versions of the operating system allowed register access at PL3. DOS system services, however, cannot be called from PL2 (although it would be technically feasible to relax this restriction in future versions of the operating system).

These restrictions mean that your direct-to-hardware graphics programs will need to move between PL3 and PL2. To move to PL2, your program has to pass through a call gate. Call gates provide the mechanism that permits your program to move from a lower privilege level to a higher one.

During a privilege-level transition, various access rights are checked to make sure that you are allowed into PL2, and you are given a different stack on which to run. If you passed any parameters to your code at PL2, they are copied to your new stack as part of the call-gate transition.

A lot more goes on during a call to a higher privilege level than you may be used to seeing during an intersegment (far) call. (By the way, call gates look like far calls when you disassemble them.) Call-gate transitions are at least four times slower, depending on the number of parameters passed, than intersegment calls at the same privilege level. Thus, you want to minimize the number of call-gate transitions that your application makes.

Although the INT 10h DOS video interface has been replaced by a rich set of video function calls in OS/2, those function calls apply only to text-mode functions and some limited support for CGA graphics modes. The only graphically oriented system service that OS/2 provides is the ability to change the display mode. All other aspects touching the graphics display must be done either by the application itself or by using external graphics routines. The one system service that OS/2 provides is useful because changing the display to a graphics mode involves more than programming the display-adapter registers; it also involves coordinating with the mouse driver and the operating system.

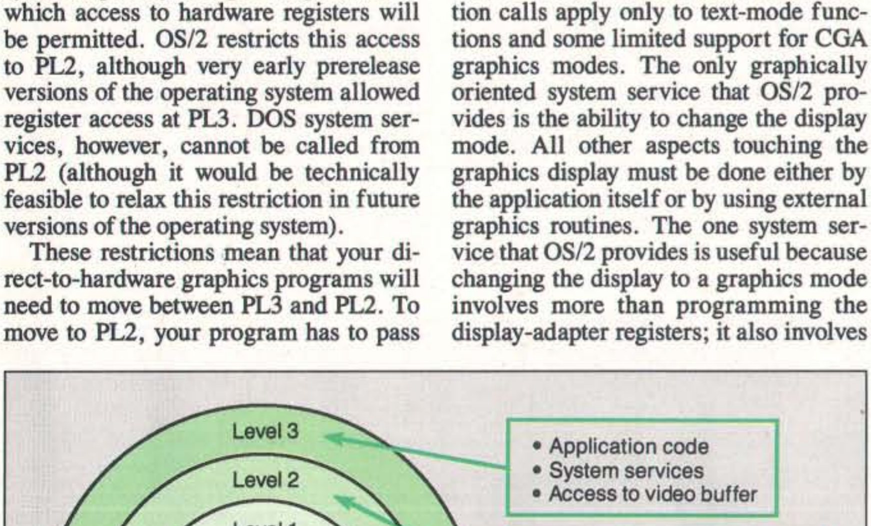


Figure 1: *The 80286 protected-mode architecture allows OS/2 to partition its running environment into privilege levels, which specify the access to system services and hardware registers. A similar drawing of real-mode DOS programming would show only one circle.*

OS/2 Multitasking Features

So far, we have concentrated on the issues you would face in a single-tasking protected-mode environment. However, OS/2's multitasking features lead to a series of considerations based on how your program will cooperate with the system in sharing "serially reusable resources" (e.g., the keyboard, the mouse, and the display screen).

Several applications may want to use these resources at unpredictable intervals, yet only one application can use them at a time. In addition, OS/2 occasionally needs to take ownership of the screen to display pop-up windows to notify the user of error conditions. OS/2 provides a series of interrelated mechanisms to resolve these potential resource conflicts.

Two key concepts on which OS/2 is based are *processes* and *threads*. Processes are units of ownership; for example, a process owns its own file handles and its own portions of memory. Threads, on the other hand, are units of execution. Every process owns at least one thread, and all threads owned by a process have equal access to everything else the process owns. When a process's last thread terminates, the process terminates with it.

Figure 2a shows a simple nongraphics (alphanumeric) application with three threads, each accessing input and display devices through system services. Figure 2b shows a graphics application with three required threads (explained below) that use system services to access the keyboard and mouse but that must use external graphics routines to access a (non-CGA) graphics display.

A thread can request permission to write to the screen, and prevent other threads from writing to the screen until it is done, through *screen locking*. Screen locking is necessary if your application has several threads, because any number of them might want to write to the screen at the same time. When one thread is done writing, it unlocks the screen so another thread can write to the screen. Although a thread can attempt to write to the screen without requesting permission (via screen locking), the result will be a screen full of "garbage."

Another important reason for a thread to lock the screen before writing to it is to coordinate *screen swapping*. Screen swapping operates on *screen groups*, which are simply entities that can own the screen, keyboard, and mouse. Each screen group can consist of multiple applications (e.g., under control of a window manager) or a single application. Screen swapping switches the foreground screen group (i.e., the application that owns the screen, keyboard, and mouse) into the background and simultaneously switches a background screen group into the foreground (see figure 3). Screen swapping can happen at any time when the screen is not locked; thus, coordination via screen locking is important.

You can also use screen locking to coordinate your application with unpredictable pop-up window displays. OS/2 uses pop-up windows to communicate errors to the user without destroying the contents of the user's display screen; background screen groups also use them to communicate messages to the user. Pop-up windows can be displayed at any time, with one exception: They will never be displayed when the screen is locked.

Pop-up windows are displayed in text mode, and they take up the entire screen. When a pop-up is taken down, OS/2 replaces the bits in the video buffer that were overwritten by the pop-up. This happens even if the display was in graphics mode before the pop-up was displayed. Incidentally, this is another reason to use OS/2's mode-setting service (so the operating system can properly save and restore the screen bits before and after a pop-up window is displayed).

Although screen locking prevents screen swapping and pop-up window displays, there is a limit to its power: If a screen swap or pop-up window display is pending, a thread has 30 seconds to unlock the screen from the time it was locked. After 30 seconds, the process that owns the thread holding the screen lock is suspended and swapped to the background.

Implications of Multitasking

Soon after your application is loaded and the main thread begins to execute, your application will need to create two additional threads. The first is called the *save/redraw wait* thread, and the second is called the *mode-restore* thread. The save/redraw wait thread handles screen swapping, and the mode-restore thread handles display-mode restoration after pop-up windows are taken down (see figure 4). Each screen group can have only one save/redraw wait thread and one mode-restore thread.

These threads are required in graphics applications because your application knows best what format to use for an off-screen bit map, where the screen bits are stored when the application is swapped to the background. Furthermore, at any given time, your application knows what state the hardware should be in after a pop-up window is taken down.

Some of your application's end users may be using IBM PC AT-compatible machines with EGA boards. Remember that EGA registers cannot be read; they are write-only. Although OS/2 can restore most of the EGA registers when it returns the display to graphics mode after taking down the pop-up window, it cannot restore them all. The mode-restore thread must restore the remaining registers.

The save/redraw wait thread interacts with OS/2 via the function called `VioSavRedrawWait`. Whenever this function is called, the calling thread is suspended until a screen swap is initiated on the thread's screen group. A screen swap

continued

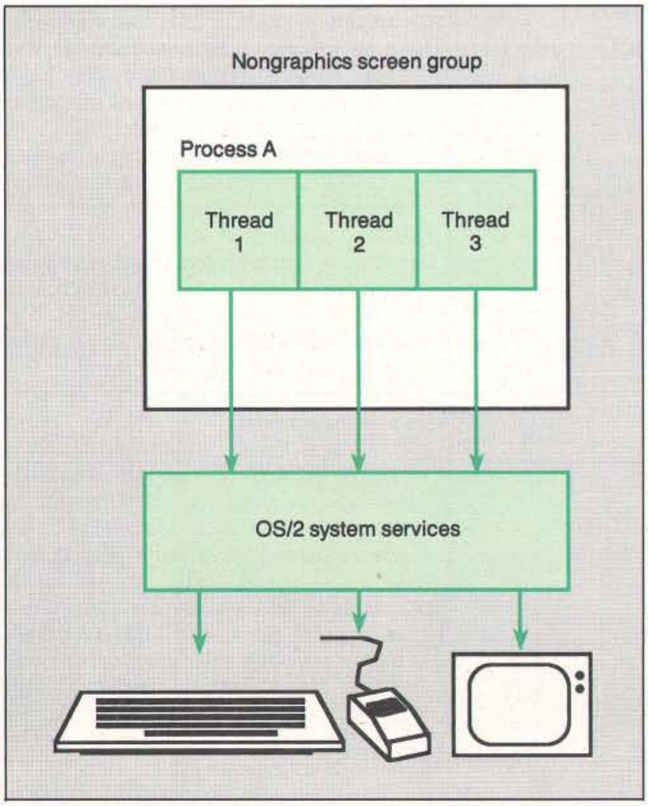


Figure 2a: *In a nongraphics (alphanumeric) OS/2 application, a process's threads access input and display devices through system services.*

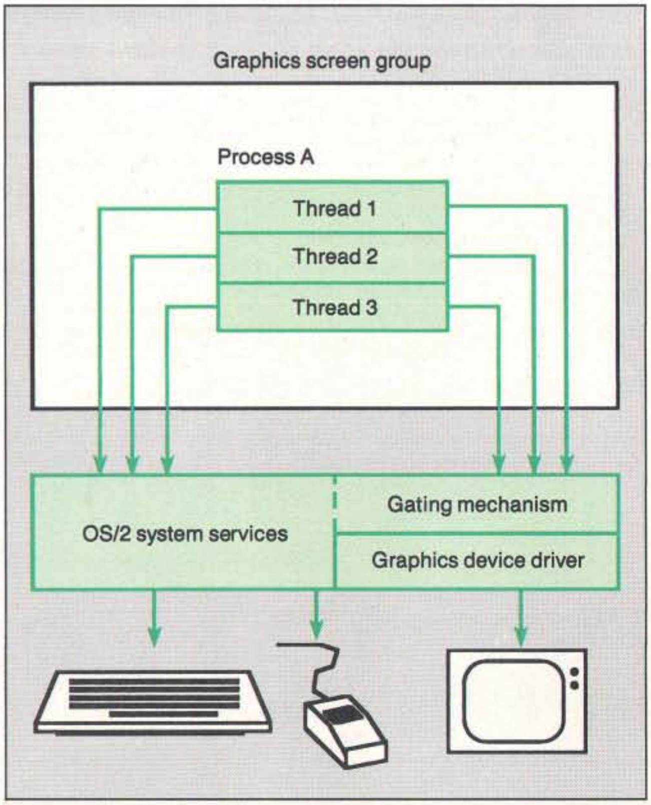


Figure 2b: *An OS/2 graphics application needs three required threads, which use system services to access the keyboard and mouse but must use external graphics routines to access the graphics display.*

in progress is signaled by the return from `VioSavRedrawWait`. A flag indicates if your screen group is being swapped to the background or to the foreground.

When it's being swapped to the background, the save/redraw wait thread must save the current screen image by whatever means are appropriate. If the screen group consists of a single graphics application, then your save/redraw wait thread should probably create an off-screen bit map large enough to hold the entire contents of the display buffer. This off-screen bit map can be created in a format that lets the application continue executing while it is in the background. Nothing in OS/2 precludes a graphics application from running in the background. However, given the complexities of redirecting output to the background video buffer, some programmers may decide to suspend the application when it is in the background.

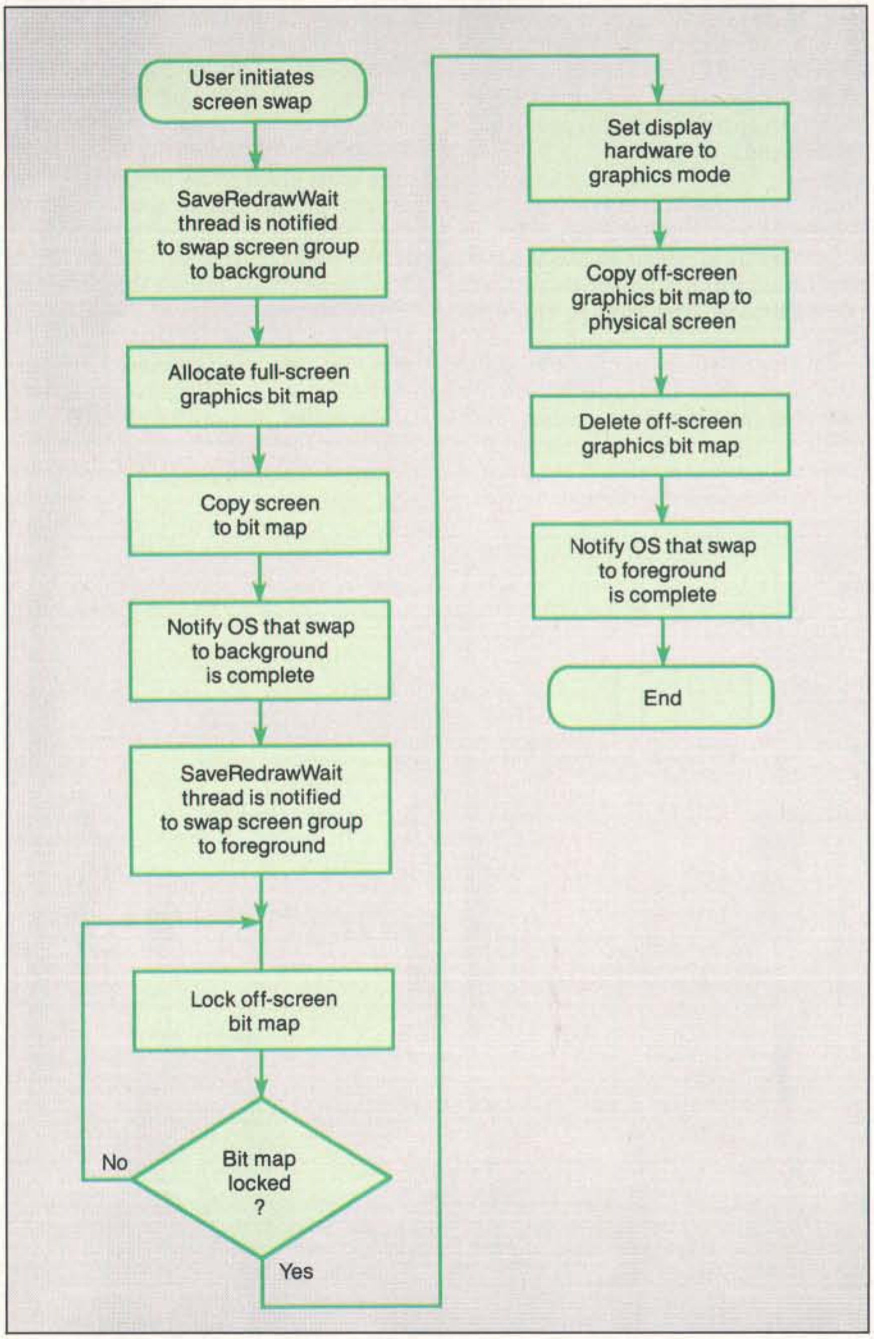

User initiates screen swap
SaveRedrawWait thread is notified to swap screen group to background
Allocate full-screen graphics bit map
Copy screen to bit map
Notify OS that swap to background is complete
SaveRedrawWait thread is notified to swap screen group to foreground
Lock off-screen bit map
Bit map locked ?
No
Yes
Set display hardware to graphics mode
Copy off-screen graphics bit map to physical screen
Delete off-screen graphics bit map
Notify OS that swap to foreground is complete
End

Figure 3: *The left-hand portion of the flowchart illustrates the first part of a screen swap, where the foreground screen group is put into the background. The right-hand portion shows the second part of a screen swap, where the background screen group is put into the foreground.*

Once the screen image is safely tucked away into an off-screen bit map (also known as a Logical Video Buffer, or an LVB, in graphics mode), the save/redraw wait thread notifies OS/2 that its job is complete. This is done by again calling `VioSavRedrawWait`. Now the screen group is truly in the background (either still running or suspended while waiting to be swapped to the foreground).

The save/redraw wait thread is also responsible for handling the screen swap to the foreground. This operation is almost a mirror image of what took place during the swap to the background. The bits in the off-screen bit map (LVB) are copied into the display buffer. However, before that can happen, the display adapter must be set to the appropriate graphics mode.

While swapping your application to the foreground, your save/redraw wait thread must make no assumptions about the state of the display hardware. It cannot assume that the previous screen group left the display adapter in a predetermined mode after it was swapped to the background. Your save/redraw wait thread should first set the display hardware and then copy the saved off-screen image into the display buffer.

Another subtle complexity of screen swapping involves the interaction of the save/redraw wait thread with other application threads that write to the display buffer. When a screen group is running in the foreground, screen locking is used to gate access to the display buffer. The screen lock will be unavailable whenever another thread has it—for example, during a screen swap or during the display of a pop-up window.

When a thread requests the screen lock (by calling `VioScrLock`), the thread has two options: 1) It can request to be blocked until the lock is available (if the lock is already available, the thread won't be blocked at all); or 2) it can request an immediate return without blocking, even if the screen lock is unavailable. In the latter case, `VioScrLock` will return a flag indicating whether the lock was obtained or not, and the requesting thread can then determine the proper course of action.

When your screen group is running in the foreground, you will probably want `VioScrLock` to gate access to the display buffer. However, when your screen group is running in the background, you must use the second `VioScrLock` option.

If you do not, OS/2 will suspend the calling thread because the screen lock is unavailable to background screen groups.

If you use the second ("no lock") `VioScrLock` option to enable your application to run in the background, you must make sure that you do not leave your off-screen bit map (now acting as the display buffer) open to being written into by multiple threads simultaneously—this would raise havoc with the bits. You also need to make sure that, during a swap to the foreground, you do not allow threads to write into your off-screen bit map while it is being copied into the physical display buffer.

To prevent those problems, you need to create your own gating mechanism for use while running in the background and during screen swaps. OS/2 provides several methods for interthread and interprocess communication. An in-depth discussion of these is beyond the scope of this article, but the basic concept is to allow only one thread at a time to have

continued

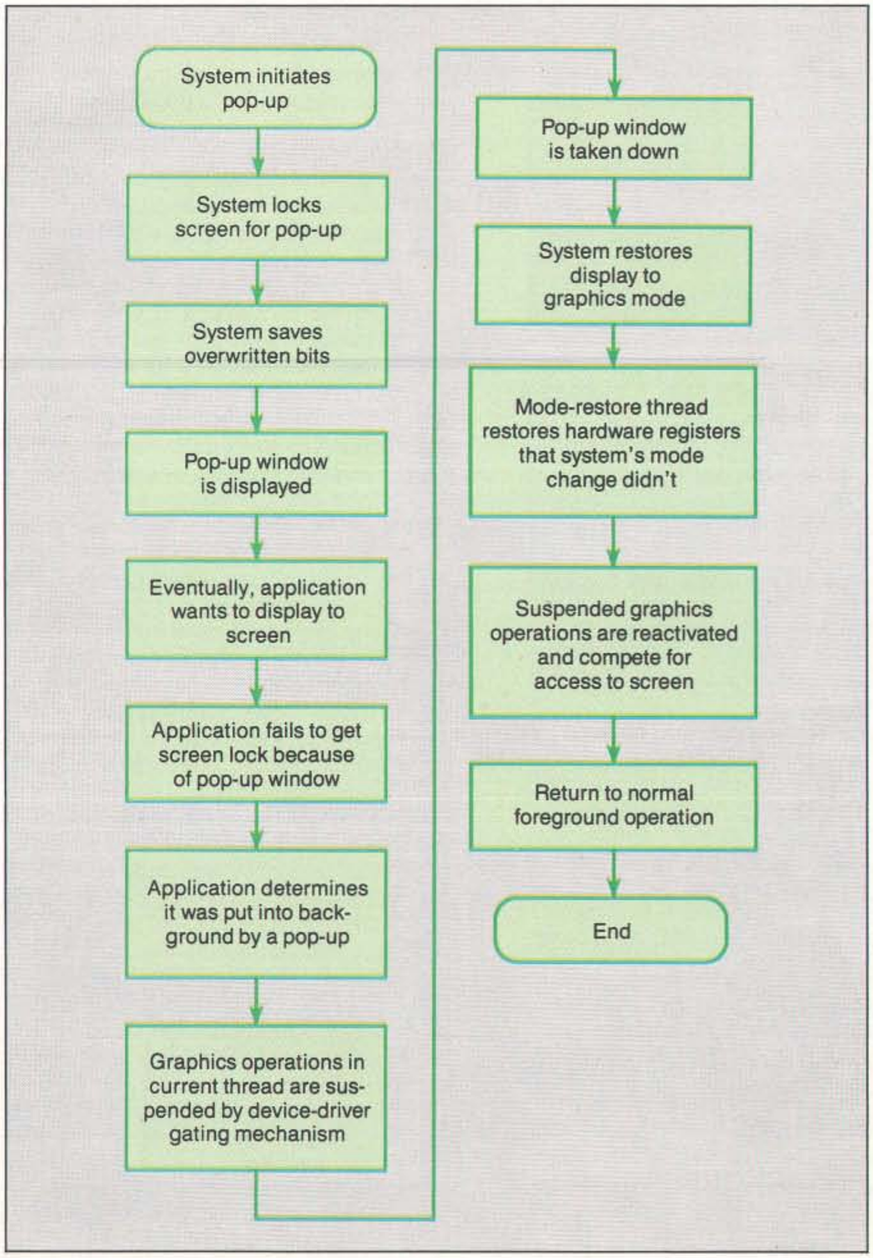

System initiates pop-up
System locks screen for pop-up
System saves overwritten bits
Pop-up window is displayed
Eventually, application wants to display to screen
Application fails to get screen lock because of pop-up window
Application determines it was put into background by a pop-up
Graphics operations in current thread are suspended by device-driver gating mechanism
Pop-up window is taken down
System restores display to graphics mode
Mode-restore thread restores hardware registers that system's mode change didn't
Suspended graphics operations are reactivated and compete for access to screen
Return to normal foreground operation
End

Figure 4: *The left-hand portion of the flowchart illustrates the display of a pop-up window and what the foreground application does in response to the event. The right-hand portion shows what happens when the pop-up is taken down.*

Subscription Problems?

We want to help!

If you have a problem with your BYTE subscription, write us with the details. We'll do our best to set it right. But we **must** *have the name, address, and* **zip** *of the subscription (new and old address, if it's a change of address). If the problem involves a payment, be sure to include copies of the credit card statement, or front and back of cancelled checks. Include a "business hours" phone number if possible.*

BYTE
Subscriber Service
P.O. Box 7643
Teaneck, NJ 07666-9866

access to the video buffer (whether it is the physical display buffer or the off-screen display buffer). We suggest that you look first at semaphores (RAM semaphores or semaphores of your own creation) as indicators of whether the video buffer is available or not.

The other thread required of graphics applications is the mode-restore thread. This thread is responsible for restoring the mode of the display adapter after a pop-up window is taken down. It must know what mode the application thought it was in before the pop-up window was displayed, but it does not have to know much else. OS/2 restores the bits in the display buffer that it overwrote with the pop-up window, so your thread does not have to deal with that.

Soon after the mode-restore thread is created, it must call an OS/2 system function called `VioModeWait`. As with the call to `VioSavRedrawWait` in the save/redraw wait thread, the thread calling `VioModeWait` is blocked until the occurrence of an event—in this case, the removal of a pop-up window from the screen. Notification is given by the return from the function. After the return, the thread restores the mode of the display adapter and then calls `VioModeWait` again, being blocked until the next time a pop-up window is taken down.

Like screen swapping, mode restoration has its subtle complexities. The mode-restore thread must cooperate with all the other threads of the screen group that want to write to the display buffer from time to time. Your screen group is never swapped to the background without the save/redraw wait thread being notified, except when a pop-up window is displayed. This doesn't present a problem if you are using `VioScrLock` to gate access to the physical display buffer. But doing that means your application will be blocked and, thus, unable to run in the background.

Alternatively, your application can run in the background if you use your own gating mechanism (you can do so in the foreground as well as in the background). You must still call `VioScrLock` to coordinate with the screen swapping and the pop-up window mechanisms (these events won't occur when the screen is locked)—but you might be calling `VioScrLock` with the "don't block if you can't lock" option. In this case, you won't get the lock because there's a pop-up window on the screen.

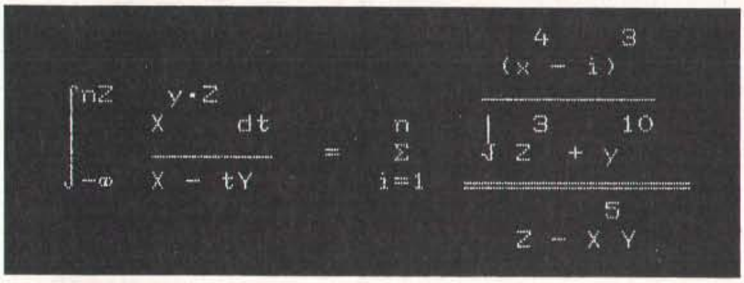
Your application must be very careful in interpreting why it didn't get the screen lock. It would be only partly correct if it assumed it didn't get the lock because it was swapped to the background. It *was* swapped to the background, but not in the normal way: The save/redraw wait thread was never started, and an off-screen bit map was not set up to save the screen. Thus, your application could end up in a state of limbo. To avoid this undesirable situation, when a pop-up swaps your application to the background, the application should go into a loop that calls `VioScrLock` until it gets the lock. Although your application's background execution would halt when a pop-up window is displayed, your application could still run in the background at other times, such as when the user swaps it out of the foreground.

Supporting Mouse Devices

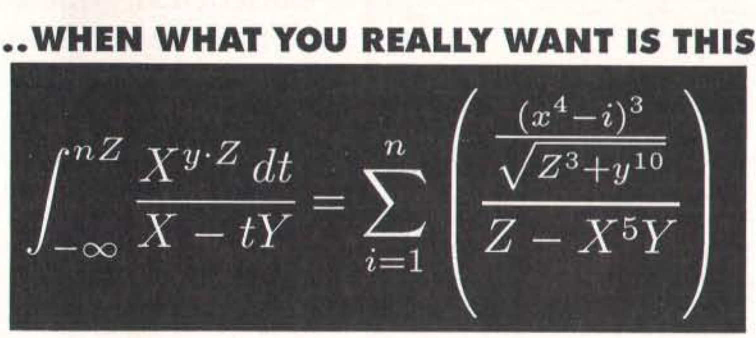
Another issue to consider when writing direct-to-hardware OS/2 graphics applications is the mouse. OS/2's designers integrated the mouse into the system so

continued

WHY SETTLE FOR THIS?...


```
                                      4     3
                                   (x  - i)
  /nZ     y·Z                    ------------
  |      X       dt       n       |  3     10
  |     ----------        Σ       √ Z  + y
  J-∞    X - tY     =    i=1    ==================
                                        5
                                   Z - X Y
```

...WHEN WHAT YOU REALLY WANT IS THIS.


$$\int_{-\infty}^{nZ} \frac{X^{y\cdot Z}\,dt}{X-tY} = \sum_{i=1}^{n}\left(\frac{\frac{(x^4-i)^3}{\sqrt{Z^3+y^{10}}}}{Z-X^5Y}\right)$$

TRY THIS:

Quality work should look high-quality. What better reason to try PCTEX®—the full implementation of Prof. D. Knuth's revolutionary TEX formatting/typesetting program.

PCTEX offers professional typesetting capabilities & advantages to PC users. It gives you control—of format, type, symbols, quality—for complex mathematical & engineering material, statistical tables or straight matter.

So whether you're writing the next starshot manual or a thesis on relativity, you get camera/publisher-ready manuscripts to be proud of, quick & simple. Don't settle for less.

From Personal TEX, Inc., starting at $249; VISA/MC welcome. Satisfaction guaranteed.

PERSONAL TEX INC

To order or for information, call:
415/388-8853
or write: Personal TEX, Inc.
12 Madrona Avenue
Mill Valley, CA 94941 USA

PCTEX is a registered TM of Personal TEX, Inc. TEX is an American Mathematical Society TM. Manufacturers' product names are their TMs.

PCTEX FORMATTING/TYPESETTING SYSTEM • **FINE TYPESET QUALITY** from dot matrix or laser printers, or phototypesetters. • **A COMPLETE PRODUCT.** Includes • our specially written PCTEX Manual that lets you use TEX immediately • custom 'macro package' formats for letters, manuals, technical documents, etc. • the LaTEX document preparation system (with user's manual) macro package for article, book, report preparation • AMS-TEX, developed by the American Mathematical Society for professional mathematical typesetting. • **OUTPUT DEVICE DRIVERS** available for Epson FX, LQ • Toshiba • HP LaserJet Series • Apple LaserWriter • Screen preview, with EGA, VGA or Hercules card. • **REQUIRES:** IBM PC/XT, AT or compatible, DOS 2.0 or higher & 512K RAM; hard disk for printer drivers & fonts.

This ad is typeset & composed using: PCTEX, Bitstream® fonts & laser printer. Logotype & black backgrounds done photographically.

Circle 172 on Reader Service Card

Circle 66 on Reader Service Card →
(DEALERS: 67)

PC
MAGAZINE

"The Dataworld 286 [12MHz] AT compatible... [is]... the fastest machine of the nine tested in that review [July 1988]." (September 1988 edition).

and

... speed and excellent compatibility ... hundreds of dollars less expensive than other AT compatible.

DATA-286 20MHz

80286 running at 20/10MHz. Phoenix or Award BIOS
1 MB of RAM expandable to 16 MB (2 MB on board)
W.D. 1:1 interleave dual hard disk controller
101-key keyboard with "click". Socket for 80287
EMS 4.0 support for memory over 1 MB. Real time clock
Monographics card w/parallel port. TTL Monitor included.

$1555.00

DATA-286 10 MHz AVAILABLE

DATA-286 12MHz

80286 running at 12/8MHz. Phoenix BIOS
512 KB of RAM expandable to 16 MB (1 MB on board)
One 1.2 floppy drive. Floppy/Hard disk controller
101-key keyboard with "click". Socket for 80287
Real time clock with battery back-up. 200W power supply
Monographics card w/parallel port. TTL Monitor included.

$1195

Vertical Case

- Front Panel On/Off Switch • 220 Watt Power Supply • Six Half Height Drive Bays • Dimensions 16¾"(D) x 7⅜"(W) x 25⅝"(H) • AVAILABLE on 286/386 Models •

Data-386

0 wait state • 16MHz (20MHz opt.) • 1MB RAM (2MB opt.) • 1.2MB FDD • 101 Key "click" touch K/B • Reset push button • 7 EXp. slots • Mono cards & monitor **$2175**

Use the same Motherboard Reviewed by PC Magazine

Portacomp I

80286CPU 12/8MHz • 0/1 Wait • 512 K RAM (Exp to 1024 K) • 5 Exp slots • Phoenix BIOS • 1.2 MB Floppy drive • 20 MB Hard Disk Drive • 200W P/S • Supertwist backlit LCD 640 x 200 25 lbs. • Par. Ser. Game Ports • RGB Output **$1875**

Use the same Motherboard Reviewed by PC Magazine

Portacomp II

80286CPU 12/8MHz • 0/1 Wait • Click K/B • 512 K RAM (Exp to 1024K) • 4 Exp slots • Phoenix BIOS • 720 KB Floppy drive • 20 MB, 39ms. Hard Disk Drive • Supertwist backlit LCD 640 x 400 • 20 lbs. • RGB Output • Opt Ext 5¼" Drive **$1975**

Prices subject to change. No charge for credit card, check, C.O.D. 30 day moneyback guarantee (Shipping charges non-refundable).

Dealer/overseas inquiries welcome

In-Calif. 1-800-722-7734 INFO: (213) 695-3777
Out-Calif. 1-800-722-7702 TECH: (213) 699-8250

Monday through Friday,
7 A.M. to 6 P.M.
Saturday 9 A.M. to 3 P.M. PST.

A PREFERRED COMPUTER SYSTEM

DATAWORLD®

3733 San Gabriel River Parkway, Pico Rivera, CA 90660-1495 that programmers would not have to write mouse drivers. But there is a problem when the display is in graphics mode.

The mouse driver knows the resolution of the screen at all times because OS/2 coordinates its mode-setting actions with the mouse driver, but it cannot display its pointer in graphics modes. It is up to your application to display the pointer at the appropriate position on the screen. For your application to control when and how the pointer is drawn, you should disable the mouse driver from doing anything other than return position reports.

National Language Support

One final consideration is working with IBM's National Language Support standard. NLS is IBM's method of using the correct character sets for various languages throughout the world. Germans, for example, have different key caps on their keyboards than do the French, and each would expect your application to display the appropriate character set for their keyboards.

OS/2 provides the means to support NLS through code pages (IBM's terminology for different character sets), but your graphics application must handle them correctly. It has to note the current code page and behave appropriately. For example, if you intend to support printers with your application, you must create images for every character in each of the five supported code pages. That sounds worse than it really is—most of the characters are duplicated in each code page—but you should be aware of this requirement.

A Variety of Approaches

We've attempted to provide some insight into the issues and challenges associated with writing direct-to-hardware graphics programs for OS/2. Clearly, it can be done—and sometimes must be done.

When you don't want to write directly to the hardware, you can use the graphics support found in high-level languages. At present, however, the high-level languages running under OS/2 generally offer limited graphics support, perhaps as a result of the rush to release OS/2 versions. This will undoubtedly change in the months to come.

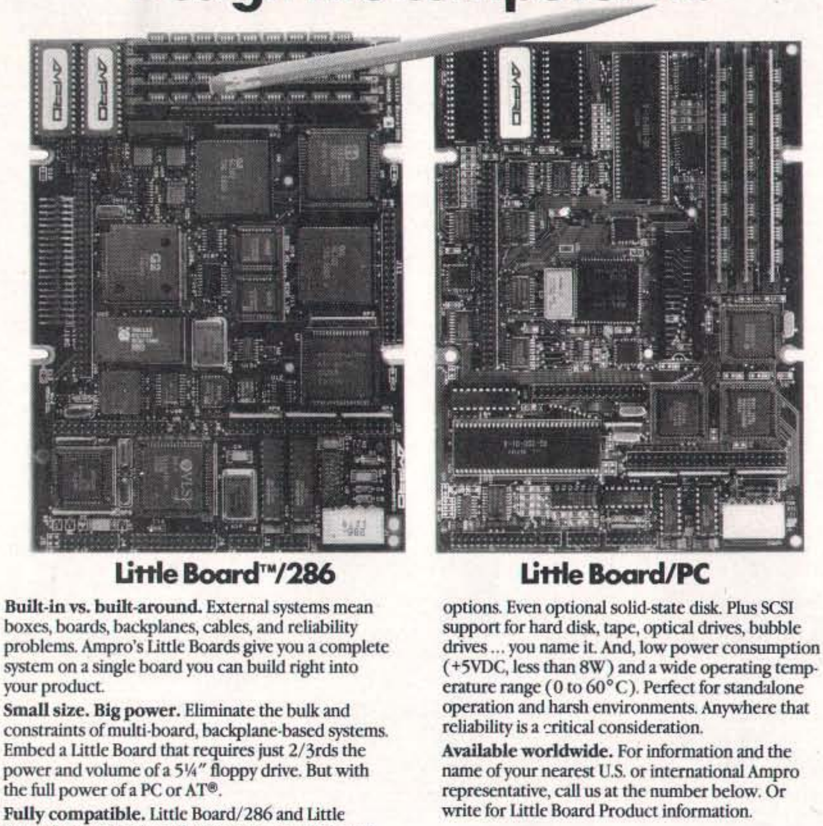
There are also two device-independent approaches to OS/2 graphics application development. The first approach is programming with a software tool (such as the GSS Graphics Development Toolkit) that provides a library of device-independent graphics functions that work through prewritten device drivers. The second is programming to a window manager (such as the Presentation Manager) that includes prewritten drivers, graphics functions, and higher-level window/icon functions that allow your application to conform to a standard "look and feel."

Each method of writing graphics under OS/2 has its advantages and disadvantages. There are times when you will want to go directly to the hardware, times when you want to support a standard window-manager environment, and times when you want to make use of a device-independent graphics toolkit. ■

Mitchell M. McLain is a senior graphics software engineer responsible for managing OS/2-based software development at Graphic Software Systems, Inc. (GSS). Timothy E. Stevenson, director of Entry Systems Engineering, is a cofounder of GSS. They can be contacted on BIX c/o "editors."

WHY DESIGN YOUR PRODUCT AROUND A COMPUTER?

Design the computer in.



Little Board™/286

Little Board/PC

Built-in vs. built-around. External systems mean boxes, boards, backplanes, cables, and reliability problems. Ampro's Little Boards give you a complete system on a single board you can build right into your product.

Small size. Big power. Eliminate the bulk and constraints of multi-board, backplane-based systems. Embed a Little Board that requires just 2/3rds the power and volume of a 5¼" floppy drive. But with the full power of a PC or AT®.

Fully compatible. Little Board/286 and Little Board/PC are functionally identical to multi-board PCs and ATs. They run PC-DOS™ 2.0 to 3.X. They run DOS languages, compilers and applications. You'll be standing on a proven foundation of hardware and software.

Ampro's Single Board Systems. It's all there. Up to a Megabyte of RAM. RS-232C and Parallel ports. AT/PC-compatible controllers and bus expansion. EGA/CGA/MDA and Hercules™-compatible video options. Even optional solid-state disk. Plus SCSI support for hard disk, tape, optical drives, bubble drives ... you name it. And, low power consumption (+5VDC, less than 8W) and a wide operating temperature range (0 to 60°C). Perfect for standalone operation and harsh environments. Anywhere that reliability is a critical consideration.

Available worldwide. For information and the name of your nearest U.S. or international Ampro representative, call us at the number below. Or write for Little Board Product information.

408-734-2800

Fax: 408-734-2939 TLX: 4940302

AMPRO
COMPUTERS, INCORPORATED
1130 Mountain View/Alviso Road
Sunnyvale, CA 94089

Reps: Australia—61 3 720-3298; Austria—43-222/45 45 01; **Canada**—(604) 438-0028; **Denmark**—45 3 66 20 20; **Finland**—358 0 585-322; **France**—331 4502-1800; **Germany, West**—49 89 611-6151; **Israel**—972 3 49-16-95; **Italy**—39 6 811-9406; **Japan**—81 3 257-2630; **Netherlands**—010-411 85 20; **Spain**—M34 3 204-2099; **Sweden**—46 8 55-00-65; **Switzerland**—41 1 740-41-05; **United Kingdom**—44 2 964-35511; **USA**—contact **AMPRO**

Trademarks: IBM, AT—IBM Corp.; Hercules—Hercules Computer Technology, Inc.; MS-DOS—Microsoft Corp.; LittleBoard - Ampro Computers, Inc.

Circle 200 on Reader Service Card →
(DEALERS: 201)

SHECOM COMPUTERS

10 MHZ 286
Mono System

- Intel 80286 6/10 MHz clock
- 640K RAM (upgradeable to 1 MEG)
- 1.2 MB 5.25" floppy drive
- 1 parallel - 1 serial I/O port
- 200 watt power supply
- 14" monochrome monitor
- 101 enhanced keyboard
- Real-time clock calendar w/battery
- 2 year warranty
- Oper. sys. w/manual & tutorial

$1,195

1 MEG RAM up-grade	**$260**
For RGB color monitor/card. add	**$180**
For EGA color monitor/card. add	**$380**
For Multiscan monitor With 800X600 contrl card	**$480**

6-8-10-12 MHZ 286 System
Monochrome

- Intel 80286 6/12 MHz clock
- 1 MEG RAM
- 1.2 MB 5.25" floppy drive
- 1 parallel - 1 serial I/O ports
- 200 watt power supply
- 101 enhanced keyboard
- 14" TTL monochrome monitor
- Real-time clock calendar w/battery
- 2 year warranty
- Oper. sys. w/manual & tutorial

$1,595

For RGB color monitor/card. add	**$180**
For EGA color monitor/card. add	**$380**
For Multiscan monitor With 800X600 contrl card	**$480**

16 MHZ 386
Mono System

- 16 Intel 80386 CPU .1 MEG RAM
- 1.2 MB 5.25" floppy drive
- 40 MB 28 MS (fast) hard drive
- 101 enhanced keyboard
- 1 parallel - 1 serial I/O ports
- 200 watt power supply
- 14" TTL monochrome monitor
- Real-time clock calendar w/battery
- 2 year warranty
- Opers. sys. w/manual & tutorial

$2,750

386 Color System

For EGA HI-REZ monitor	**$380**
For Multiscan monitor With 800X600 card	**$480**

8088-TURBO SYSTEMS

5/8 MHz-1 floppy-mono-clk/cal-256K	**$645**
5/8 MHz same as above w/640K	**$785**
5/10 MHz same as above +2 floppies	**$895**
5/10 MHz as above +RGB	**$10,900**
5/10 MHz as above +EGA.	**$12,850**

- 2 year warranty
- Opers. sys. w/manual & tutorial

TOSHIBA
Laptop Computers

T1100 plus 5/8 MHz w/640k	**$1,480**
T1200 as above + 20 MB h.dr. (New w/backlite twist LCD)	**$ CALL**
T3100/20 w/20 MB hard drive	**$2,990**
T3200 6/12 MHz 286 w/40 MB	**$3,695**
T5100 8/16 MHz 386 w/40 MB	**$4,795**

ONE YEAR WARRANTY

IBM PS2

30-002 10MHz 8086 2 drives	**$1,250**
30-021 10MHz 8086 20mb HD	**$1,695**
50Z-031 10MHz 286 30mb HD	**$2,950**
50Z-061 10MHz 286 60mb HD	**$3,400**
70-E61 16MHz 286 60mb HD	**$4,435**
70-121 20MHz 286 120mb HD	**$5,915**
8503 12" monochrome monitor	**$ 205**
8513 12" color monitor	**$ 545**
8513 14" color monitor	**$ 475**
8514 16" color monitor	**$1,250**
5.25" 1.2mb external drive	**255**
Pro-printer II 80col 200cps	**440**
Pro-printer X-24 80col 240cps	**650**

IBM & PS/2 are registered Trade Marks of International Business Machine Corp. USA

COMPAQ

Deskpro 286-20 12 MHz 20mb HD.	**$2,520**
Deskpro 286-40 12 MHz 40mb HD	**$3,150**
Deskpro 386-60 20 MHz 60mb HD	**$5,875**
Deskpro 386-130 20 MHz 130mb HD.	**$7,235**
VDU Board	**$ 170**
VGA Board	**$ 525**
11" Amber or Green Monitor	**$ 230**
14" Videographic Color Monitor	**$ 565**
Portable-II/4 8MHz 20mb HD	**$2,950**
Portable-III/20 12MHz 20mb HD	**$4,850**
Portable-386/40 20MHz 40mb HD	**$6,355**
512k-2mb upgrade kit for 286	**$ 405**
1-2mb upgrade kit for 386	**$ 595**

Compaq & Deskpro are the registered trade marks of Compaq Computer Corporation USA

CHIPS - CHIPS - CHIPS

Simm—Sipp—Modules	**$ CALL**
256-120/100/80ns	**$ CALL**
1 MEG all speeds	**$ CALL**
287 Math-Co's all speeds	**$ CALL**
387 Math-Co 16 & 20 MHz	**$ CALL**
80387 16 MHz	**$ CALL**
80387 20 MHz	**$ CALL**
2754/256 EPROMS	**$ CALL**

DRAMS SRAMS ALSO AVAILABLE

LAZER PRINTERS

HP Laser Jet	**$1,750**
Panasonic 4450	**$1,595**
Toshi Pagelaser-12	**$2,650**

SCANNERS

Panasonic (With contrl card & software)	**$995**

COMPUTER ACCESSORY SECTION

TAPE BACKUPS & ADD-ONS

Irwin-120/5 20 MB XT/AT	**$380**
Irwin-145 20 MB AT Internal	**$515**
Archive 40 MB XT/AT	**$ CALL**
Archive 60 MB Internal	**$ CALL**
Archive 60 MB External	**$ CALL**
1200 Bauds internal modem	**$ 85**
1200 Bauds external modem	**$155**
2400 Bauds internal modem	**$180**
2400 Bauds external modem	**$240**

MS DOX 3.3 with GWBSIC & manual	**$105**
OS/2 ver1 oper sys & manual	**$280**
2mb XT/AT/PS2 Rampage with 512k on	**$450**
800x600 Genoa super EGA card	**160**
800x600 Genoa 5100 super VGA card	**370**
1024x768 Genoa 5200 super VGA hi-res	**520**
13" Technika PGA/VGA/EGA monitor/std	**440**
15" Idek MGA/PGA/VGA/EGA/CGA monitor	**610**
13" Sony 1302 multiscan monitor .26m	**$645**
13" Sony 1303 multiscan monitor .37m	**$510**
14" phosphor white monocrome monitor	**$145**

HARD DRIVES

ST-225 20mb half height 65ms	**$255**
ST-238 30mb half height 65ms	**$290**
ST-251-2 40mb hh 40ms	**$395**
ST-251-1 40mb hh 28ms	**$475**
ST-4096 80mb full height 28ms	**$750**
Miniscribe 8425 20mb 3.5" 28ms.	**$345**
Miniscribe 3053 40mb hh 28ms	**$590**
Miniscribe 6085 80mb fh 28ms	**$790**

FLOPPIES

Toshi/Fuji/Epson 360 K	**$ 75**
Epson/Nec 1.2 MB	**$ 95**
Toshi/Panasonic 760 K	**$110**
Nec/Toshi 1.4 MB	**$120**

CONTROLLER CARDS

20/30 MB cntrl card	**$ 50**
20/30 WD AT C/Card	**$ 90**
20/30 WD RLL Card	**$ 60**
20/30 WD Adpt RLL	**$ 55**

PRINTERS

Panasonic

KX1080i 144cps draft/28cps NLQ+cond. mode	**$180**
KX1091i 192cps draft/38cps NLQ+cond. mode	**$215**
KX1092i 240cps draft/48cps NLQ+cond. mode	**$329**
KX1592i 180cps draft/38cps NLQ+cond. mode	**$429**
KX1595 240cps draft/51cps NLQ+cond. mode	**$459**
KX1524 240cps draft/160cps text+80LQ+cond.	**$580**

TOSHIBA

P321SL 216 cps draft/72cps LQ 3 fonts built-in.	**$ 495**
P341SL 216 cps draft/72cps LQ 3 fonts built-in	**$ 625**
P351SX 360 cps draft/120cps LQ 6 fonts built-in .	**$1,025**
Color upgrade for P351SX	**$230**

(ALL PRINTERS INCLUDE 6' CABLE)

OKIDATA

ML182+ 180/30cps NLQ	**$ 245**
ML192+ 200/40cps NLQ	**$ 360**
ML292 240/100cps NLQ	**$ 495**
ML390 24-pin 350cps	**$ 510**
ML391 wide carriage	**$ 690**

SHECOM COMPUTERS, INC.
22755-G Savi Ranch Parkway
Yorba Linda, CA 92886
FAX (818) 912-5017

Call before you buy and SAVE! SAVE! SAVE!

Most orders shipped with 48 hours or less

Ask for our Desktop Publishing CAD/CAM/CAE System Packages & Apple & Add-Ons & Enhancements

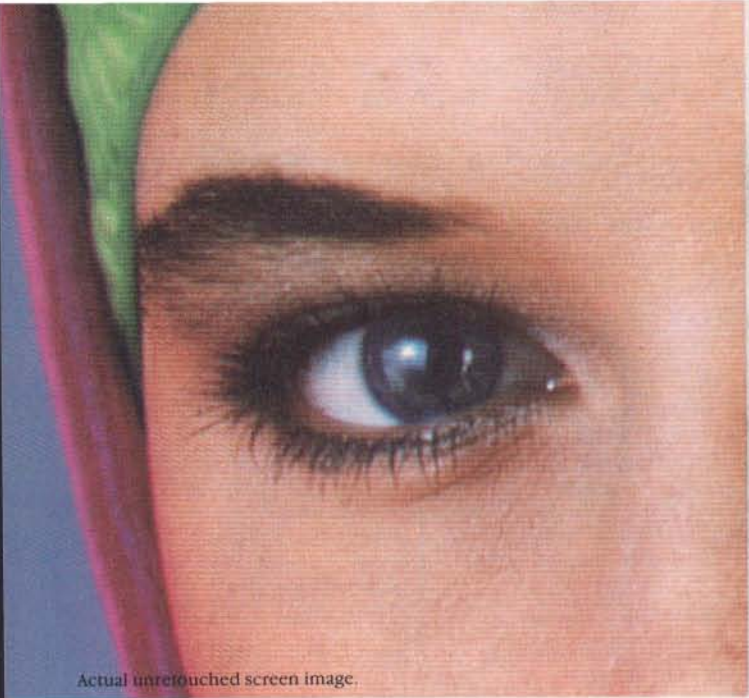
HOURS M-F 8 a.m.—6 p.m. SAT 11 a.m.—3 p.m. PACIFIC TIME

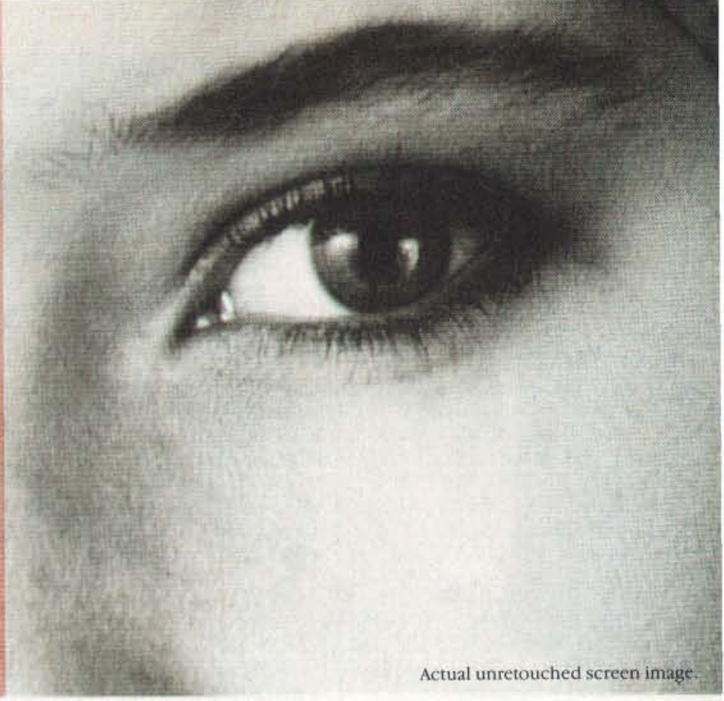
Prices subject to change without notice

INQUIRIES 714-637-4800

TECH SUPPORT 714-637-5921

SALES ORDERS CALL 1-800-366-4433


Actual unretouched screen image.


Actual unretouched screen image.

Screen stars with The Visible Edge.

What gives Princeton's new generation of screen stars the Visible Edge is a screen image of incomparable clarity and resolution. Where brilliant colors and infinite shades of gray, with striking contrast and dimension, are commonplace.

The versatility of the Princeton family of monitors gives the new generation (and present generation) of computers, the greatest autosynchronous horizontal/vertical scan range combination available (ULTRASYNC and MAX-15). The clarity of .28mm dot pitch (ULTRASYNC and PSC-28). 1024x750 display resolution (MAX-15). And the entire spectrum of color, with the ease and comfort that can only accompany an ergonomically designed monitor.

Experience a world of unlimited vision. And the technology that's made our high level of quality, service, value and performance, second nature. Experience the Visible Edge. And see what we do best. For more information call (609) 683-1660 x 100.

PSC-28

PSM-03

Compatibility: IBM PC, XT, AT, PS/2, Apple Macintosh SE

ULTRASYNC

MAX-15

Compatibility: IBM PC, XT, AT, PS/2, Apple Macintosh II, SE

NOW AVAILABLE FOR ULTRASYNC:
AC-100 DATA CABLE FOR MAC II

PRINCETON®
GRAPHIC SYSTEMS
THE VISIBLE EDGE

601 Ewing Street, Building A, Princeton, New Jersey 08540 (609) 683-1660

Circle 249 on Reader Service Card

VGA VIDEO MODES

Complete control of IBM's VGA system

Richard Wilton

The VGA is the video subsystem built into IBM's PS/2 Models 50, 60, and 80. It is also widely available as an adapter for the IBM PC XT and AT. In terms of capability and performance, the VGA is essentially a mildly improved version of the EGA. Surprisingly, however, the VGA is much more flexible than the EGA in terms of the resolution of the video modes that it can display, particularly when you use it with a variable-frequency video monitor.

Like the EGA, the VGA has several programmable control components, including a CRT controller (CRTC), a sequencer, an attribute controller, and a graphics controller. You can program each to modify essential timing signals and addressing modes within the video subsystem. The VGA's ROM BIOS contains a set of routines, invoked through interrupt 10 hexadecimal function 0, that program the VGA controllers into any of 24 different configurations (video modes).

Each of the VGA's controllers has a number of registers whose contents control their function. The VGA ROM BIOS contains tables of appropriate register values for each supported video mode, so most programmers call the ROM BIOS to select video modes instead of updating the registers directly. If, however, you want to create video modes unsupported by the video BIOS, you need to know what values to store in these registers to obtain the video configuration you want.

Why take the trouble to create your own video modes? The usual reason is to obtain higher-resolution graphics or more displayed text than the usual ROM BIOS video modes can provide. Some widely used commercial applications, including Microsoft Word and Lotus 1-2-3, can do this for you. If you want higher resolution in your own applications, however, you need to do some extra programming yourself.

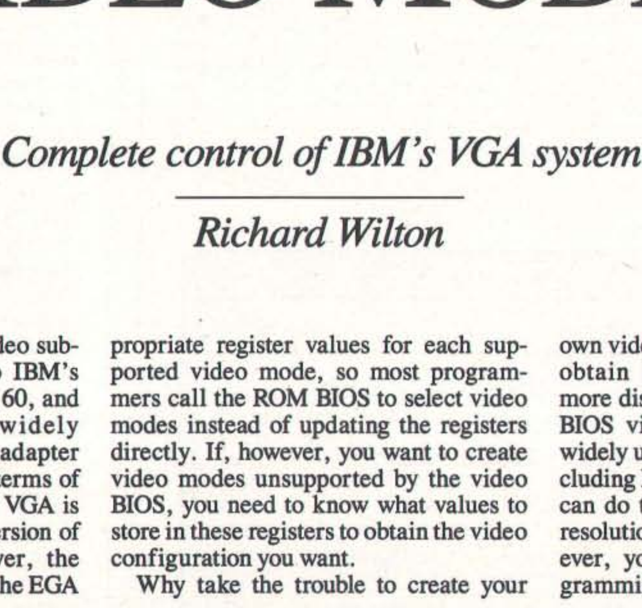


ILLUSTRATION: CHRIS SPOLLEN © 1988

Video Mode Control

You can differentiate video modes from each other in several ways:

- Vertical resolution: number of rows of pixels (scan lines) displayed on the screen.
- Horizontal resolution: number of characters or pixels per row.
- Data representation in the video buffer.
- Attribute decoding: colors, blinking, and so on.

When you program the VGA, you have a great deal of control over vertical and horizontal resolution. You have much less flexibility in regard to data representation and attribute decoding because of the VGA's hardware design. For this reason, the easiest

continued

way to set up alternative VGA video modes is to use the ROM BIOS mode-set routines to establish a baseline video mode, and then modify the horizontal and vertical resolution to produce a new video mode.

Video Display Timing

Controlling the resolution of the displayed image is—like many other activities in life—a matter of timing. Both horizontal and vertical resolution are related to the timing of the VGA's output signals that control the electron beam in the video monitor. The image on the video screen is not static, of course. It is produced by the cyclic sweep of the monitor's electron beam across and down the screen (see figure 1). The screen image is completely refreshed between 50 and 70 times per second, depending on the video mode.

As each scan line of pixels is displayed, the electron beam's intensity is modulated by signals generated by the VGA. (In a color monitor, there are three adjacent electron beams, one for each primary color, but for the purposes of video display timing, they can be regarded as a single beam.) The monitor moves the beam from left to right at a constant rate across each scan line and downward from scan line to scan line. The VGA generates a horizontal sync signal that controls when the monitor deflects the beam from the rightmost end of one scan line to the start of the next scan line (horizontal retrace). There is also a vertical sync signal that controls the deflection of the beam from the bottom of the screen back to the upper left corner (vertical retrace).

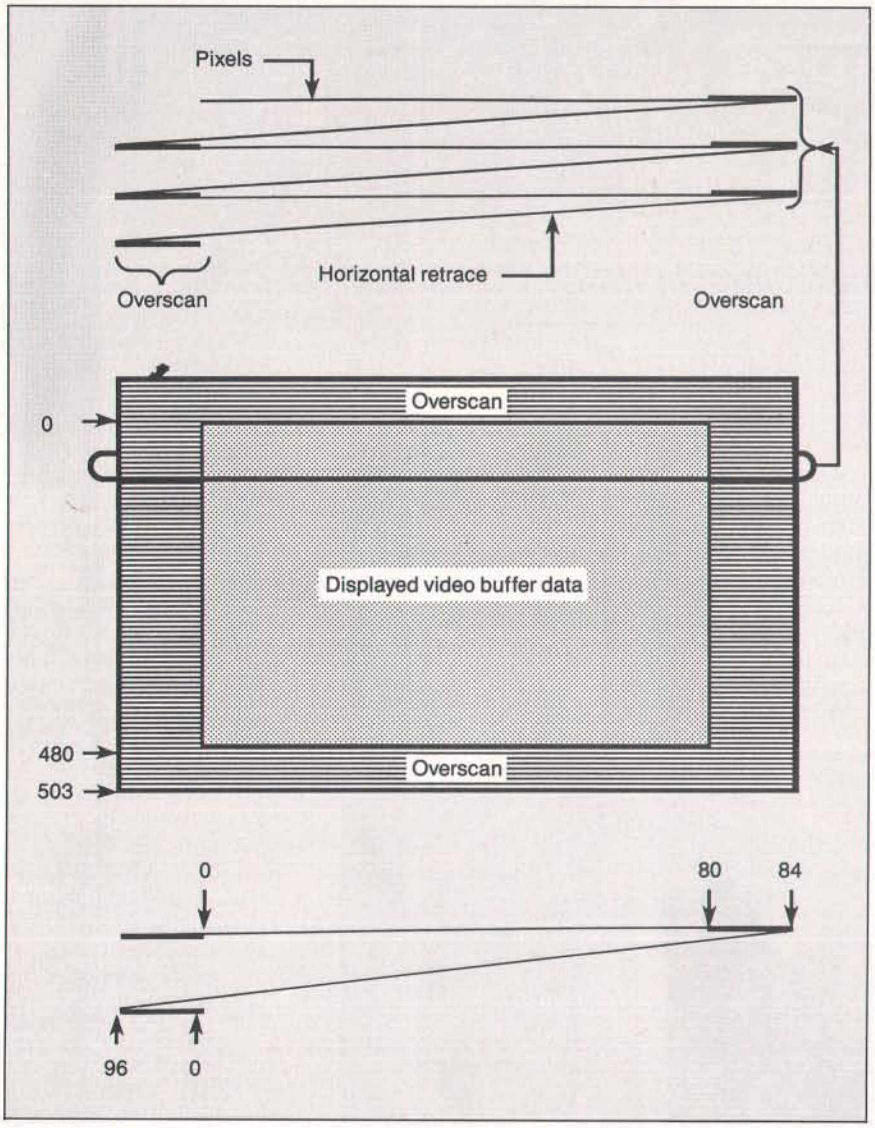


Figure 1: *On a video screen, the electron beam's scan cycle starts with the first pixel of the displayed video buffer data near the upper left corner of the screen. Scan lines are traced horizontally, left to right, then retraced down and across, right to left. In one scan line of a 640- by 480-pixel 16-color graphics mode, the horizontal total (100) specifies the duration of one complete horizontal scan cycle. Horizontal displayed (80) specifies the amount of displayed data. Horizontal sync starts at character clock 84 and lasts for 12 character clocks, so there are 4 characters of overscan at each end of the scan line. The vertical displayed (480) specifies the number of scan lines of displayed data. Vertical sync starts at scan line 503 and lasts for 2 scan lines, so there is a total of 42 scan lines of vertical overscan above and below the screen image.*

The VGA is always programmed so that the amount of time required to display data from the video buffer is less than the total amount of time it takes to sweep the electron beam horizontally and vertically. The extra time is spent in horizontal and vertical overscan. You can assign a color to the overscan area (also known as the border area) of the screen to provide a visual frame for the displayed video data, but that area's basic purpose is to center the displayed image on the screen.

You can control the horizontal timing signals generated by the VGA's CRT controller by updating the appropriate CRTC registers. The timing values that you store in these registers are measured in "character clocks." A character clock corresponds to 8 pixels in VGA graphics modes and either 8 or 9 pixels in alphanumeric modes. You might want to think of a character clock as a unit of time (i.e., the time required to display one character's worth of data on the screen).

The key parameters that control horizontal timing are as follows:

- *Horizontal total*. The total amount of time spent in displaying each scan line, including the time required for horizontal retrace.
- *Horizontal displayed*. The number of character clocks of data displayed from the video buffer in each scan line. The difference between the horizontal total and the horizontal displayed parameters describes the amount of horizontal overscan.
- *Horizontal sync*. The character clock at which the horizontal sync pulse begins.

continued

· Call for FREE Catalog · Call for FREE Catalog · Call for FREE Catalog · Call for FREE Catalog · Call for FREE Catalog · Call for FR

The New **PC NETWORK** 625 ACADEMY DRIVE NORTHBROOK, IL 60062

PRICE BREAKTHROUGH

T.H.E. Complete Computer Systems

Complete Monochrome System $554.00*

Complete Color System $798.00*

- 512K Expandable to 640K RAM
- 360K Disk Drive
- 10Mhz Speed
- 101 Key Keyboard
- LED w/Keylock
- Serial/Parallel/Game/Clock
- Hercules Monochrome Video Card
- HI-RES 12" Monochrome Monitor
- FREE 1-Year Warranty
- Pheonix Bios & More!

(MS DOS & GW Basic $59.59 w/ System Purchase)

PC MAGAZINE *"THE" PC is well built and has enough company support behind it to make it a very attractive alternative to higher pricedcompetition.*

- 512K Expandable to 640K RAM
- 360K Disk Drive
- 10Mhz Speed
- 101 Key Keyboard
- LED w/Keylock
- Serial/Parallel/Game/Clock
- CGA Color Video Card
- HI-RES 14" RGB Color Monitor
- FREE 1-Year Warranty
- Pheonix Bios & More!

9600 Baud Modem, Hayes Compatible

The Last Modem You'll Ever Buy

$399*

- 1200, 2400, & 9600 Baud
- Software Included
- Internal Card
- Hayes Compatible
- Built-in Speaker
- Auto Answer, dial, redial

386/16

- 1MB RAM · 32Bit 16 Mhz Operational · 200 Watt Power Supply · 101 Key "AT Style" Keyboard · 1.2 MB Floppy Driver · Western Digital Hard/ Floppy Controller · Pheonix Bios Monitor Optional

$1,790*

Hard Drive Super Sale

Seagate ST-251

- 42MB Half Height Hard Drive
- 40MS Access Time

$349.00*

MiniScribe

$360.57*

- 42MB half Height Hard Drive
- 40MS Access Time

Seagate ST-225

20MB Half Height Hard Drive Kit **$249.00***

EPSON PRINTERS

LX800	80 Col., 180cps	176.00*
LQ500	80 Col., 180cps	CALL
LQ1050	132 Col., 246cps	CALL
FX1050	132 Col., 264cps	CALL
FX850	80 Col., 264cps	CALL

1-800-621-SAVE

Corporate & Export Hotline **1-312-205-1300**

MONDAY-FRIDAY 8:30AM-6:00PM

SATURDAY 10:00AM-4:00PM

TECH SUPPORT 1- 312-205-1410
CUSTOMER SERVICE 1-312-205-1510
FAX 1-312-205-1525
MONDAY-FRIDAY 9:00AM-4:30PM

MMC

BY1088

REAL BUYING CLOUT- Call now and join over 200,000 members who are too smart to pay more! **MEMBERSHIP BENEFITS:** * Pay just 8% above advertised wholesale price · 3%cash discount (included in wholesale price) · Price Protection · Optional software rental library · FREE Wholesale Buyers Guide · FREE UPDATES · Fully Insured 48 Hour Delivery · 10 day Return Policy · FREE Technical Support · FREE Bulletin Board · Quantity Discounts · All Prices Subject To Change. All Products Subject To Availability. **JOIN TODAY FOR AS LITTLE AS $10.**

*All Prices Shown are Wholesale Prices

· Call for FREE Catalog · Call for FREE Catalog · Call for FREE Catalog · Call for FREE Catalog · Call for FREE Catalog · Call for

· Come Visit Our Computer Warehouse Club Outlet Store · Come Visite Our Computer Warehouse Club Outlet Store · Come Visit Our Computer Warehouse Club Outlet Store · Cor

Come Visit Our Computer Warehouse Club Outlet Store · Come Visit Our Computer Warehouse Club Outlet Store · Come Visit Our Computer Warehouse Club Outlet Store · Co

Circle 170 on Reader Service Card

Table 1: *Tolerances of a few VGA-compatible monitors.*

Monitor	Dot rate (MHz)	Maximum vertical scan rate (kHz)	Horizontal scan rate (Hz)
IBM 8503 (monochrome)	28	31.5	50-70
IBM 8513 (color)	28	31.5	50-70
NEC MultiSync	30	35	56-65
NEC MultiSync Plus	30	45	56-80
Electrohome ECM 1310	30	34	47-85
Sony Multiscan CPD 1302	25	34	50-100
Princeton Ultrasync	30	35	45-120

Table 2: *I/O ports used for VGA control.*

Port	Function	Access
3C0	Attribute controller	Read/write
3C2	Miscellaneous output	Write only
3C4/3C5	Sequencer	Read/write
3CC	Miscellaneous output	Read only
3CE/3CF	Graphics controller	Read/write
3D4/3D5*	CRT controller	Read/write

* 3B4/3B5 in modes 7 and 0Fh.

The timing parameters that control the vertical size and on-screen location of the displayed image are analogous to those that control horizontal timing. Vertical timing parameters are usually specified in terms of number of scan lines. As with character clocks, you might want to consider a scan line to be a unit of time (i.e., the amount of time it takes to draw one scan line on the screen and return the electron beam to the beginning of the next scan line).

Here are the vertical timing parameters you need to consider when you establish a VGA video mode:

- *Vertical total.* The total number of scan lines in one complete refresh cycle.
- *Vertical displayed.* The number of scan lines of data displayed on the screen. The difference between the vertical total and the vertical displayed parameters determines the amount of vertical overscan.
- *Vertical sync.* The scan line in which the vertical sync pulse begins.

VGA Timing Constraints

In order to use these general timing parameters to program the VGA, you need to know the basic timing frequencies used by the VGA and by your video monitor. There are three different control-signal frequencies or rates to consider: The rate at which pixels are displayed, the rate at which the electron beam sweeps across the scan lines, and the rate at which the entire screen image is refreshed. These three rates are commonly called the dot rate, the horizontal scan rate, and the vertical scan rate.

- *Dot rate.* The rate at which the video subsystem displays pixels is called its dot rate; this frequency is also known as the pixel rate or the video bandwidth. This rate is established by a high-frequency crystal oscillator called the dot clock. You can program the VGA to use one of several dot clocks with different frequencies. Two different crystal oscillators are built into the VGA with frequencies of 25.175 MHz and 28.322 MHz; you can select a third oscillator from the auxiliary video connector on the system board of a PS/2 Model 50, 60, or 80.
- *Horizontal scan rate.* The horizontal scan rate is the number of scan lines displayed per second. When you program the VGA, you indirectly specify a horizontal scan rate by specifying the total number of pixels contained in each scan line. If you divide the dot-clock frequency by the total number of pixels per scan line, you get the horizontal scan rate.
- *Vertical scan rate.* The vertical scan rate (also called the refresh rate or frame rate) is the number of times per second that the screen is refreshed. You determine the vertical scan rate by programming the VGA to display a specified number of scan lines during each refresh cycle. You can calculate the vertical scan rate by dividing the horizontal scan rate by the number of scan lines per frame.

The key to establishing alternative VGA video modes lies in programming the VGA to produce timing signals that fall within the limitations of your monitor. When you set up a video mode by programming the VGA, you must select a dot rate, horizontal scan rate, and vertical scan rate that lie within the tolerances of the monitor you're using. I've listed the tolerances of a few VGA-compatible monitors in table 1.

For example, consider the default ROM BIOS video mode 12h—that is, 640- by 480-pixel 16-color graphics mode. This mode is designed to work with IBM's PS/2-compatible monitors, which expect a horizontal scan rate of 31.5 KHz. The BIOS uses the VGA's 25.175-MHz dot clock in this video mode, so you can easily determine the relevant timing constraints.

To compute the horizontal total, you divide the dot rate by the horizontal scan rate to obtain the number of pixels per scan line. Then you divide this value by 8 (the number of pixels per character clock) to determine the number of character clocks per scan line:

$$\text{Horizontal total} = (25175000/31500)/8$$
$$= 100 \text{ character clocks}$$

Since each scan line contains 640 pixels of data, the horizontal displayed parameter is 640 divided by 8, or 80. The extra 20 character clocks represent the time spent in horizontal overscan and in horizontal retrace. To center the displayed pixel data, the horizontal sync signal starts at the eighty-fourth character clock, and the horizontal sync pulse lasts for 12 character clocks. The result is a scan line with 4 character clocks of overscan at each end.

The ROM BIOS relies on similar calculations to determine the vertical timing parameters. The BIOS sets up this video mode so that 60 frames are displayed per second. This vertical scan rate lies in the middle of the tolerance range of IBM's PS/2 video monitors. The vertical total, measured in scan lines, is the quotient of the actual horizontal scan rate (scan lines per second) and the desired vertical scan rate of 60 frames per second:

$$\text{Vertical total} = (25175000/(100 \times 8))\ /\ 60$$
$$= 524 \text{ scan lines}$$

continued

New! PCX MULTI-LINE VOICE MAIL FOR YOUR PC

Are You Buying Your Computer Needs From a Pusher?

If you like buying at a discount, but hate dealing with uninformed key pushers that take your orders, you're ready for an alternative source for quality computer components: The On-Line Store's WHOLESALE + 7% Club.

Offering more than just a good price, a well-informed sales staff at the On-Line Store knows what to ask to make sure the products meet your particular needs. And, since they're also responsible for customer service and product support, they're not going to want to make any mistakes. *Key pushers? They just take orders.*

And now, you can get a *free* membership — simply place an order for $100 or more, tell where you saw this ad, and you'll be able to buy — with all the advantages of the On-Line Store's full customer support system — at just 7%* over wholesale for an entire year. In addition, you'll receive unlimited access to their revolutionary multi-line BBS with literally hundreds of free programs — yours for the taking. PLUS you'll find a multitude of other specials too numerous to mention in this ad.

MODEMS

FAMOUS BRAND 2400 Baud Modem **$89***
Hayes Compatible • 2 Yr. Warranty

ALL NEW 4800 BAUD MODEM with LEV 5 MNP **$189***
Hayes Compatible • 2 Yr. Warranty

FASTCOMM 9600 By MASTERCOM **$389***
Hayes Compatible • 2 Yr. Warranty

USRobotics

2400 Internal Modem	$ 129*
2400 External Modem	189*
4800 Int Lev 5 MNP	NEW
9600 Courier HST Ext	589*

MultiTech Systems

2400 Rack-Mount Modem	$ 299*
4800 With Lev 5 MNP	369*
9600 V.32 High Speed	999*

MULTI-LINE VOICE MAIL

PCX is a *real voice* multi-line Telemarketing System and Voice/Mail Exchange with hundreds of features such as call routing, questionnaires, multiple voice messages, autodialing, remote access, and call forwarding. Optional versions allow one PC to accommodate up to 16 phone lines simultaneously. *From* **$269**

For a live demonstration of PCX, our Multi-Line Voice Mail Card, please call ***805/654-0721.***

AWARD WINNING SYSTEMS

65 MB
HARD DRIVE SYSTEM
386/20

NOW ONLY **$1995** *Full Cash Price*

Financing Available

REVOLUTIONARY NEW DESIGN

- 80386/20 Intel Processor
- 80387 Co-Processor Slot
- 1MB Expand to 9 MB RAM
- 65 MB Hard Disk

PORTABLE 286/386
Built to Your Specs:
Flat panel
LED Display

286/12 MHz	$ 899*
386/20 MHz	CALL

30 MB
HARD DRIVE SYSTEM
286/AT

$995 *Full Cash Price*

Financing Available

- 80286/10 Intel Processor
- 80287 Co-Processor Slot
- VGA/EGA Graphics Card
- 30 MB Hard Disk
- IBM & 0S2 Compatible System
- Your Choice of Optional Monitors

FAX SYSTEMS

JT/FAX has features such as pull-down windows, multiple scheduling and Broadcast FAX and runs unattended. Input: scanner or word processor. Output: dot matrix or laser printer. Compatible with all Group III FAX. *PC Editor's Choice.*

4800 Baud Int. Fax Card	$ 269*
4800 Baud External Fax	349*
9600 Baud Int. Fax Card	499*
High Res. Scanner Option	269*

ACCESSORIES

Alloy PC/Slave (512K)	$ 599*
Alloy 40 MB Tape B/U	299*
Quadram 386/16 1 MB	799*
Quadram 386/20 1 MB	899*

EPSON PRINTERS

LX800	150 CPS/80 COL	9 PIN	$ 199*
FX86e	160 CPS/80 COL	9 PIN	299*
LQ800	180 CPS/80 COL	24 PIN	379*
EX800	300 CPS/80 COL	9 PIN	399*
FX286e	200 CPS/132 COL	9 PIN	459*
EX1000	300 CPS/132 COL	9 PIN	499*
LQ850	264 CPS/80 COL	24 PIN	499*
LQ1000	100 CPS/132 COL	9 PIN	499*
LQ1050	264 CPS/80 COL	24 PIN	669*
LQ2500	324 CPS/132 COL	24 PIN	889*

286 SYSTEM COMPARISON

OUR 286/12	IBM AT	PC LTD.	COMPAQ 286	AST 286
15.3	10.0	13.3	11.5	11.5

TOSHIBA

360K 5¼" Floppy	$ 79*
1.2MB 5¼" Floppy	99*
1.4MB 3½" Floppy	109*
130MB HARD DISK *Now*	899*

MINISCRIBE

MS-3650 40MB w/Cont	$ 389*
MS-3675 New 65MB HD	439*
MS-6085 80MB w/Cont	699*

SEAGATE

ST-238 30MB w/Cont	$ 289*
ST-251 40MB/40ms *Now*	369*
ST-251-1 40MB/28ms	439*
ST-4096 80MB/28ms	599*

SAMSUNG

12" Flatscreen T/S Base	$ 89*
14" EGA/CGA T/S Base	369*
14" Multi-Sync & VGA	469*
DTP Vert. Monitor 1024×780	995*

VIDEO DISPLAY CARDS

Quadram VGA *Save ½ Off*	$ 219*
Video-7 VGA/EGA Card	269*
Genoa 800×600 EGA/GEM	189*
Orchid Designer VGA	279*
Mono Card w/Parallel	49*

*ALL PRICES SHOWN ARE WHOLESALE AND REFLECT AN ADDITIONAL 3% CASH DISCOUNT. THE ON-LINE STORE'S WHOLESALE +7% CLUB MEMBERS PAY JUST 7% ABOVE THE WHOLESALE PRICE, PLUS SHIPPING AND HANDLING. Minimum shipping: $5.00 per order. International orders: call for rates. All prices subject to change. Products subject to availability and may be private label versions. WE ALSO SERVE LARGE CORPORATE ORDERS: call for information. This ad supersedes all previous.

BBS **805/650-0193** FAX **805/650-0195**

Customer Service
805/650-0188
Mailing Address
3037 Golf Course Drive
Ventura, CA 93003

Some Products In Limited Supply. CALL NOW!
24 Hour Order Line: **805/650-0188**

Visit us at COMDEX/FALL, Tropicana, Booth T-300.

ON LINE STORE
Your Data Communications System Specialist

Circle 177 on Reader Service Card

The vertical displayed parameter is 480, the number of rows of pixel data that are displayed in this video mode. The remaining 44 scan lines represent vertical overscan plus the time required for vertical retrace. The BIOS starts vertical retrace after 503 scan lines and specifies the duration of the vertical sync pulse to be 2 scan lines. Thus, the 480 scan lines of video data are displayed with a total of 42 (524−480−2) scan lines of vertical overscan above and below.

Video-Mode Programming

Once you decide what the horizontal and vertical timing parameters will be for a video mode, you can program the VGA to display it. There are five tasks you must perform to coordinate the different components of the VGA subsystem:

- Program the CRTC.
- Program the sequencer.
- Select a dot-clock frequency.
- Specify the displayed character height.
- Update relevant ROM BIOS variables.

You program the VGA's controllers through a set of I/O ports (see table 2). You must access these ports with either assembly language `IN` and `OUT` instructions or their high-level-language equivalents. To access the ROM BIOS, you need to execute interrupt 10h, either directly in assembly language or through a high-level-language construct such as the `int86()` function in Microsoft C.

Most of the VGA's control over the horizontal and vertical timing parameters is obtained through the CRTC. The CRTC controls the duration of the horizontal and vertical timing signals sent to the monitor. It also synchronizes the timing signals with the rate that data is extracted from the video buffer and processed by the display circuitry. You control these functions by updating the appropriate CRTC registers (see table 3).

Table 3: *VGA CRT controller registers used for video-mode programming.*

Register number	Name	Contents
0	Horizontal total	[Horizontal total] − 5
1	Horizontal display enable end	[Number of character clocks of displayed data] − 1
2	Start horizontal blank	Character clock at which horizontal blanking begins
3	End horizontal blank	End of horizontal blanking pulse (bits 4-0 only)
4	Start horizontal retrace	Character clock at which horizontal sync begins
5	End horizontal retrace	End of horizontal sync pulse (bits 4-0 only)
6	Vertical total	Vertical total (bits 7-0 of a 10-bit value)
7	Overflow	Bit 0: vertical total bit 8 Bit 1: vertical display enable end bit 8 Bit 2: start vertical retrace bit 8 Bit 3: start vertical blank bit 8 Bit 5: vertical total bit 9 Bit 6: vertical display enable end bit 9 Bit 7: vertical retrace start bit 9
9	Maximum scan line	Bits 4-0: [scan lines per character] − 1 Bit 5: start vertical blank bit 9
10h	Start vertical retrace	Scan line at which vertical sync pulse starts (bits 7-0 of a 10-bit value)
11h	End vertical retrace	Bit 7: write-protect CRTC registers 0-7 Bits 3-0: scan line at which vertical sync ends
12h	Vertical display enable end	Number of scan lines of displayed video data (bits 7-0 of a 10-bit value)
13h	Offset	Logical line width of video buffer data in words
15h	Start vertical blank	[Scan line at which vertical blanking begins] − 1 (bits 7-0 of a 10-bit value)
16h	End vertical blank	Scan line at which vertical blanking ends (bits 7-0)

To update a CRTC register, you must write a register number to I/O port 3D4h and then write the register's new value to port 3D5h (see listing 1).

Listing 1: *Updating a CRTC register.*

```
cli            ; disable interrupts
mov al,RegNumber  ; AL = register number
mov dx,3D4h
out dx,al     ; write to port 3D4H
mov al,RegValue     ; AL = new register value
inc dx
out dx,al     ; write to port 3D5H
sti            ; enable interrupts
```

Listing 2: *Unlike previous graphics adapters, the VGA's control registers can be read as well as written.*

```
cli             ; disable interrupts
mov al,RegNumber ; AL = register number
mov dx,3D4h
out dx,al         ; write to port 3D4H
inc dx
in  al,dx   ; AL = register value
sti             ; enable interrupts
```

There are a couple of tricks to CRTC programming on the VGA. First, you can use a single 16-bit port write to obtain the same results:

```
;AL = register number
 mov al,RegNumber
;AH = new register value
 mov ah,RegValue
 mov dx,3D4h
;Write to port 3D4h/3D5h
 out dx,ax
```

continued

PS/2 PS/TOO
FAST HARD DISCS

IN SIZES FROM 20 Mbytes TO 120 Mbytes

With CMS Enhancements products and Seagate* technology, you have the right team for the PS/2.**

You too can give your PS/2 customers all the advantages of superior Seagate technology when you choose CMS Enhancements. We have a wide range of internal hard disk subsystems for the PS/2. And with them comes lightening fast average access speeds of 28 to 35 milliseconds. So act fast and call or write today for complete information.

Seagate

CMS ENHANCEMENTS, INC.

1372 Valencia Avenue, Tustin, California 92680
(714) 259-9555

We can enhance every advance.

CMS Enhancements, Inc. is a public company. NASDAQ symbol: ACMS

*Registered trademark of Seagate Technology, Inc.
**Registered trademark of International Business Machines Corporation

Come see us at COMDEX, Booth #570.

Circle 46 on Reader Service Card (DEALERS: 47)

If you don't use 8-bit port accesses, be sure to clear the interrupts. Otherwise, a hardware interrupt may occur between the port writes and disrupt your program by transferring control to a service routine that does its own CRTC programming.

Also, if you're programming in ROM BIOS modes 7 or 0Fh, use ports 3B4h and 3B5h instead of 3D4h and 3D5h. These port addresses mimic those that are used in the Monochrome Display Adapter; they let you operate both a VGA and another color video subsystem in the same computer.

Unlike the control registers in previous IBM video subsystems, you can perform both reads and writes to the VGA's control registers (see listing 2). This is particularly convenient because it lets you save the current state of the CRTC registers before you modify them.

The VGA sequencer has several interrelated functions, including synchronization of the video subsystem's character clock with the dot clock. The character clock determines the rate at which bytes of data from the video buffer are displayed. You can set the character clock so that one character is displayed every 8 or 9 ticks of the dot clock. In other words, each byte of data in the video buffer may be displayed as either 8 or 9 horizontal pixels, depending on how you program the sequencer.

In default VGA alphanumeric modes, the VGA displays 9 pixels for each character on the screen. In EGA-compatible 350-line alphanumeric modes and in graphics modes, the system programs the sequencer to display 8 pixels per character. The extra (ninth) pixel increases the sharpness of displayed text, but omitting the extra pixel allows you to display more characters across the screen.

Table 4: *VGA sequencer registers used for video-mode programming.*

Register number	Name	Contents
0	Reset	Bit 1: synchronous reset
1	Clocking mode	Bit 0: 1=8 pixels per character 0=9 pixels per character

Table 5: *VGA dot-clock selection through the miscellaneous output register (I/O port 3C2h).*

Bit 3	Bit 2	Dot-clock frequency
0	0	25.175 MHz
0	1	28.322 MHz

Listing 3: *Programming the VGA's sequencer to produce 8 pixels per character.*

```
cli ; disable interrupts
mov dx,3C4h
mov ax,0100h   ; AH = value for Reset register:
             ; bit 1 = 0; bit 0 = 1
out dx,ax  ; Sequencer synchronous reset

mov al,1   ; AL = Clocking Mode reg number
out dx,al
inc dx
in  al,dx  ; AL = Clocking Mode reg value
dec dx

or  al,1   ; set bit 1
mov ah,al  ; AH = new Clocking Mode reg value
mov al,1
out dx,ax  ; update Clocking Mode register

mov ax,0300h   ; AH = value for Reset register:
     ;  bit 1 = 1; bit 0 = 1
out dx,ax
sti
```

You would access sequencer registers through I/O ports 3C4h and 3C5h (see table 4). The same programming techniques I've shown to access the CRTC will work for accessing the sequencer registers, but there is a catch: When you select a new dot clock or change the number of pixels per character, you must temporarily reset the sequencer by toggling bit 1 of its reset register. An example of this is in listing 3, which programs the sequencer to generate 8 pixels per character.

Bits 2 and 3 of the VGA's miscellaneous output register specify which dot clock frequency to use (see table 5). You can update this register by reading I/O port 3CCh to obtain its current value, masking bits 2 and 3, and then writing port 3C2h. When you do this, however, you should temporarily reset the sequencer, as in the previous program example.

In default alphanumeric modes, the video BIOS configures the VGA to display 25 rows of characters. For example, in 400-line alphanumeric modes (the power-on default), each character is 16 scan lines high. You can modify any alphanumeric mode to display more than 25 rows of characters simply by using shorter characters that are displayed in fewer scan lines.

Bits 0 through 4 of CRTC register 09h, the maximum scan-line register, control the displayed height of alphanumeric characters. The value in this bit field is one less than the character height in scan lines. Thus, in default alphanumeric modes, the value in bits 0 through 4 is 01111 binary (0Fh). If, for example, you change this value to 00111 binary (07h), the CRTC would display only 8 scan lines per character, so you would have a video mode that consisted of 50 character rows instead of 25.

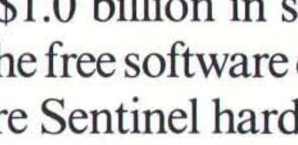
Although you can update the maximum scan-line register directly, it is usually better to use the ROM BIOS to do the work for you. The ROM BIOS provides considerable flexibility in setting the displayed height of alphanumeric-mode characters because it lets you select an appropriate character set at the same time. For example,

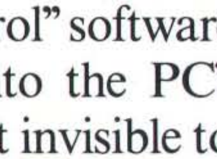
```
;AH = 11h (ROM BIOS function
 number)
;AL = 12h (subfunction number)
 mov ax,1112h
```

continued

In 1988, $3.5 billion in microcomputer software will be sold worldwide. During that same time, another

$3.0 billion in sales will be lost to free distribution — better known as software piracy. And right now, Rainbow Technologies' Software Sentinel™ is protecting close to $1.0 billion in software for developers who never wanted to be part of the free software distribution network in the first place. The Software Sentinel hardware key is "execution control" software protection. It ships with the software and simply plugs into the PC's parallel port to be one hundred percent invisible to both user and the software. Users can make as many copies as they want. Make working submasters. Use a hard disk. Virtually anything that can be done with unprotected software. Except start freely distributing that software to other users. The Rainbow family of Software Sentinel products. Selected by the very big to the not-so-big developers of DOS, OS/2 and Xenix software in worldwide markets. To the cool tune of close to a billion dollars. So far.





Come see us at COMDEX, Booth W747.

RAINBOW TECHNOLOGIES

18011-A Mitchell South, Irvine, CA 92714 • (714) 261-0228 • TELEX: 386078 • FAX: (714) 261-0260
Rainbow Technologies, Ltd., Shirley Lodge, 470 London Rd., Slough, Berkshire, SL3 8QY, U.K., Tel: 0753-41512, Fax: 0753-43610

Copyright ©1988 Rainbow Technologies, Inc. Software Sentinel and SentinelPro are trademarks of Rainbow Technologies, Inc.
Xenix is a trademark of Microsoft Corporation. OS/2 is a trademark of International Business Machines Corporation.

Circle 188 on Reader Service Card (DEALERS: 189)

```
 mov bl,0
;Call the video BIOS
 int 10h
```

This sequence calls the video BIOS to display a character set in which each character is only eight scan lines high. The BIOS loads the character set into the hardware character generator, programs the CRTC appropriately, and updates its global data area with the new number of character rows displayed.

Two Examples

I've created two programs that automate the process of calculating the CRTC register values for different video modes. (I used Microsoft C 5.0 to compile these programs. If you use another vendor's C compiler, you may need to rewrite the references to the `int86()` library call that invokes interrupt 10h.) The alphanumeric-mode program, AVMODE, lets you specify the number of displayed character columns, the size of the displayed character matrix, and an optional horizontal adjustment factor that helps to center the screen image. For example, you can create a 90-column mode that uses 8 by 8 characters by running the program with this command:

```
AVMODE 90 8 8
```

If the resulting image is not centered horizontally, you can also specify an adjustment to the horizontal sync position. For instance, you could shift the image one character position rightward by executing the program with the following:

```
AVMODE 90 8 8 -1
```

The program uses the video BIOS character-generator interface to give the CRTC the specified height of the character matrix. It then programs the sequencer to display characters that are either 8 or 9 pixels wide. The rest of the program sets up the CRTC with horizontal timing parameters appropriate for the number of characters to be displayed.

For simplicity, AVMODE.C performs all its sequencer and CRTC programming in high-level subroutines. In practice, however, you should probably use assembly language to do this. The reason is that the C functions `inp()` and `outp()` compile as subroutine calls instead of in-line `IN` and `OUT` instructions. This means that subroutines that call `inp()` and `outp()` (e.g., `SetSeqReg()` and `SetCRTCReg()`) are somewhat lengthy and too susceptible to interference from hardware interrupts to be thoroughly reliable.

You will find that an IBM VGA (in a PS/2 Model 50, 60, or 80) or IBM VGA adapter can produce an alphanumeric mode with about 96 8-pixel characters per row using an IBM PS/2 monitor. Higher resolutions exceed the tolerances of IBM's monitors.

If you use a variable-frequency monitor, you can push the VGA up to 132 characters per row. (Of course, the characters are pretty tiny when you squeeze 132 in a row.) You will probably have to adjust the vertical hold control on your monitor, because the vertical scan rate with a 132-character alphanumeric mode is only 51.5 Hz. Also, you may notice that the screen image flickers when you display a large, bright field of color; this, too, is a consequence of the low vertical scan rate.

Use the PC-DOS `CLS` command with caution if you use AVMODE to change the number of displayed character rows. The video BIOS keeps track of the number of character rows in a byte in its global data area at address 0040:0084h, but PC-DOS ignores this value and assumes that there are always 25 rows of data to clear. If you program the CRTC to display 50 lines of data, `CLS` clears only the top half of the screen. To avoid this problem, you could write your own screen-clear command (see listing 4), using interrupt 10h function 6.

GVMODE, the graphics-mode example, requires you to specify the number of pixels to be displayed horizontally and vertically. For example, to set up a 720- by 480-pixel 16-color graphics mode, you execute GVMODE as follows:

```
GVMODE 720 480
```

The program uses the desired resolution to select which of the VGA's dot clocks to activate. This lets GVMODE produce a wider range of video modes than it could if it relied on just one dot-clock frequency. Apart from these small differences, however, GVMODE's operation is similar to that of AVMODE.

With an off-the-shelf IBM VGA and PS/2-compatible monitor, you can use GVMODE to produce a graphics mode with about 720- by 512-pixel resolution, although displaying this many pixels pushes IBM's analog monitors to their limits. However, 800- by 600-pixel resolution is well within the tolerances of a non-IBM variable-frequency monitor.

Again, higher resolutions imply lower vertical scan rates. You may find that the resolution you want to use in your programs is limited by the amount of per-

continued

FREE!
Turn-key
PC Systems
Handbook
NEW 1988 Fall/Winter Edition

The PC SYSTEMS HANDBOOK for SCIENTISTS and ENGINEERS
In a hurry? Call 203-786-5151 Ext 101

Save Time and Money
Over 1000 Hard-to-find Hardware and Software Items of Special Interest to Technical PC Users:

144 Pages
Available Now

- RS 232/IEEE 488 Networks
- Stepping & Servo Motor Controls
- Ruggedized PC's
- Rack Mtg. 80286 & 80386
- Laboratory Automation
- 1 MHZ A/D
- Digital Scopes to 200 MHZ
- High Speed Bus Adapters
- Waveform Synthesizers
- Data Loggers
- PC Bus Expansion Chassis
- And Much More

A How-to-Handbook that enables you to configure the BEST products from the world's leading PC hardware and software vendors into risk free turn-key system solutions that meet your needs.

Toll Free Hotline for application assistance and convenient one stop shopping at competitive prices. 100% Satisfaction Guaranteed.

Call or write for a FREE handbook today!
203-786-5151 Ext. 101
(9:00 AM to 5:00 PM E.S.T)

CyberResearch inc.
P.O.Box 9565, New Haven, CT 06536
Fax: 203-786-5023 Telex: 9102501037

Circle 65 on Reader Service Card

LIONHEART
BUSINESS & STATISTICAL SOFTWARE

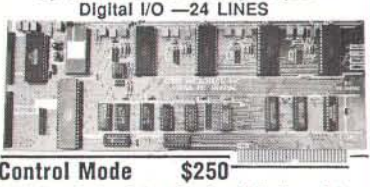
Explanatory books with professional compiled software; the new standard for statistical use. The influential Seybold Report on Professional Computing has this to say about Lionheart "...our sentimental favorite because of its pragmatic approach to the basic statistical concepts... The thinking is that the computer merely facilitates the calculations; the important thing is to be able to formulate a problem correctly and to determine what type of analysis will be most valuable. Let Lionheart help you get ahead of the competition!

• EXPERIMENTAL STATISTICS	$145
• BUSINESS STATISTICS	145
• MARKETING STATISTICS	145
• QUALITY CONTROL	145
• BIOMETRICS	145
• ECONOMETRICS	145
• FORECASTING AND TIME-SERIES	145
• SALES AND MARKET FORECASTING	145
• PROJECT PLANNING	145
• DECISION ANALYSIS TECHNIQUES	145
• OPTIMIZATION	145
• LINEAR & NON-LINEAR PROGRAMMING	95
• MULTIVARIATE ANALYSIS	125
• REGRESSION	95

SEND FOR FREE BROCHURE
P.O. BOX 379, ALBURG, VT 05440
(514) 933-4918

Circle 126 on Reader Service Card

PC DIADAC $375
Take Control With Your IBM PC/Clone
16 Channel, 12 Bit Analog Input
Up to 4 Channel Analog Output
Digital I/O —24 LINES



Control Mode $250
New Software Package Features: Data Base Modifications • Analog Device Display • Contact Input Device Display • Contact Output Device Display • Contact Output Control • **Future Software Enhancements:** Sequential Control Package will allow the user to build complex control sequences for home security, energy management and many other applications • Archive Data Storage • Report Generation - log of device valued over several selectable time intervals using archival data • T:ending - A plot of device value versus a selectable time interval.

UnkelScope Level 1 $349
UnkelScope™ - latest advance in data acquisition, process and experiment control - complete Software Tool for the Lab. Developed at MIT's Dept. of Mech. Eng.Transforms PC into one of the most powerful lab instruments, yet the price is minimal.

A Data Acquisition Package
UnkelScope™ is a trademark of M.I.T.

CORS MICROTECH
Dealers/Representatives Please Call
P.O. Box 102L • Langhorne, PA 19047
(215) 757-0284

Circle 43 on Reader Service Card

ML5000
Floppy Disk
Certifier

Are poor quality diskettes ruining your reputation?

Introducing the MediaLogic Low Cost Solution

Not all disks are equal

Floppy disks that pass MediaLogic's stringent level of ANSI* tests prove that all disks are not equal. Even if they're tested to your specifications, the quality can vary from lot to lot—from supplier to supplier.

Now there's a low cost easy-to-use tool to test $3^1/_2''$ and $5^1/_4''$ floppy disks during incoming inspection and quality assurance that goes even beyond your own specifications.

The AT based ML5000 is the certifier chosen by OEMs because it was developed specifically for them. Up to four different disk drives can be configured to meet all your certification requirements. A high resolution color monitor displays results in real time and test data can be stored on hard disk for statistical analysis, as you need it. So when you want to evaluate diskette standards for duplication or re-evaluate your own specifications beyond source inspection, the ML5000 is the only certifier that offers more than other certification processes.

More choice of tests

In addition to precise amplitude, resolution, saturation curve and extra/missing pulse, the ML5000 also includes peak shift evaluation, ANSI and ECMA** modulation and overwrite capabilities, allowing you a greater choice of comparisons. These advanced technical capabilities go beyond what you'd expect. Understanding what's available could make a significant impact on your future media handling operations.

When you think all disks are tested equally—think again. Ask the right questions. What certification methods does your media manufacturer use? Do they evaluate beyond the minimal extra pulse and missing pulse tests? Can returned disks be screened for disk or duplication defects? Technicalities. Lack of them could be the reason you're still getting burned on rejected and returned disks.

More than a floppy disk tester

- When you add a $3^1/_2''$ or $5^1/_4''$ autoloader to the system you have a volume incoming inspection tester—capable of meeting the many requirements of your customers.
- With a spin stand, the precision head positioning makes it a formatting and duplication analyzer. Or a production head tester. For head and media testing—it's a quality assurance tool.
- And when you need to test 2 Mbyte, 4 Mbyte and barium ferrite media—**the ML5000 can do it all.**

MediaLogic offers many more options for companies who stake their reputation on the quality of the media they select—once we know what you're looking for. Whether you're running quality assurance programs or adding your label to diskettes you think are tested, it pays to look at the industry standard product for quality control—the MediaLogic ML5000—**before you purchase.**

But don't take our word for it, ask your media manufacturer if they test to all ANSI standards—and then ask your customers what they prefer.

Contact your local representative and get all the facts about the ML5000 and the family of MediaLogic test products that are built for quality-conscious companies.

See us at COMDEX
Booth 1944 Bally's

Corporate headquarters:	MediaLogic Inc., 310 South Street, P.O. Box 2258, Plainville, MA 02762, U.S.A. **(508) 695 2006**
Representatives:	
U.S.A.	WME Systems, Westlake Village, CA **(818) 706 0845**
International	Media Service International, France **(33-1) 30.66.12.95**
Japan	Jastam Corporation, Japan **(03) 558 2411**

MEDIALOGIC

The most logical choice for media manufacturers and OEMs of quality certification

*American National Standards Institute
**European Computer Manufacturers Association
AT is a registered trademark of IBM Corp.

Circle 136 on Reader Service Card

Listing 4: *A custom screen-clear program.*

```
;
; Name: vgacls.asm
; Function: Clearscreen routine for
; alternative VGA video modes
; Notes: Build executable file by
;  assembling and linking, e.g.
;       MASM VGACLS;
;       LINK VGACLS;
;
CodeSeg SEGMENT byte
        ASSUME  cs:CodeSeg,ss:StackSeg
VGAcls  PROC    far
        mov  ah,0Fh      ; AH = INT 10H function number
        int  10h         ; Get video status:
; AH now = displayed char. columns
; AL now = video mode
; BH now = current video page
        push bx          ; save BX and AX on stack
        push ax
        mov  ax,1130h    ; AH = 11H (INT 10H function number)
                         ; AL = 30H (subfunction number)
        int  10h         ; Get character generator info:
                         ;  DL = [displayed character rows]-1
        pop  ax          ; restore AX
        mov  dh,dl       ; DH = last row on screen
        mov  dl,ah
        dec  dl          ; DL = last column on screen
        sub  cx,cx       ; CH = 0 (first row on screen)
                         ; CL = 0 (first column on screen)
        mov  bh,7        ; BH = default alphanumeric attribute
        cmp  al,7
        jle  L01         ; jump if alphanumeric mode
        xor  bh,bh       ; BH = default graphics attribute
L01:    mov  ax,0600h    ; AH = 6 (INT 10H function number)
                         ; AL = 0 (number of lines to scroll)
        int  10h         ; Scroll up (clear screen)
        pop  bx          ; BH = current video page
        xor  dx,dx       ; DH,DL = 0 (new cursor location)
        mov  ah,2
        int  10h         ; Set cursor location to upper left
        mov  ax,4C00h
        int  21h         ; call DOS to terminate program
VGAcls  ENDP
CodeSeg ENDS

StackSeg SEGMENT stack
         DB      800h dup(?)
StackSeg ENDS
         END     VGAcls
```

ceptible flicker on the screen at lower vertical scan rates. [Editor's note: *The source code for AVMODE.C and GVMODE.C is available in a variety of formats. See page 3 for details.*]

VGA Clones

The ICs that IBM used in the VGA subsystem are proprietary. IBM's competitors have been forced to reverse-engineer the VGA hardware to produce the same capabilities in their own products. This means that a VGA clone may not necessarily be hardware-compatible with an IBM VGA. Two ways the clones may differ are in the values stored in the control registers and in the dot-clock frequencies you can use.

The register-programming techniques I've described are not applicable to all VGA subsystems because not all VGA clone makers have designed their CRT controllers to use the same register values as IBM's. For example, when you try to program the CRTC on Video Seven's VEGA VGA, you'll discover that many of the CRTC registers require different values than they do with a true-blue IBM VGA. Other adapters, including the Paradise VGA Plus, expect the same register values as an IBM VGA, so programming these clones is much easier.

Manufacturers of VGA clones generally implement higher-resolution, non-IBM video modes using a higher-frequency dot clock. For example, the Paradise VGA Plus uses a 36.000-MHz dot clock in 132-column alphanumeric modes and in 800- by 600-pixel graphics modes. With the higher dot-clock rate, the resulting horizontal and vertical scan rates in these modes are higher than they are when you use a true-blue VGA's 28.322-MHz dot clock. The scan rates are much closer to the middle of the tolerance range of most monitors, and the increased vertical scan rate results in less flicker.

Alternative Video Modes

Clearly, these alternative VGA video modes are not for everybody. Using them requires some understanding of how the video subsystem works. However, if you're writing a program that does full-screen text or graphics output, you should be able to incorporate support for alternative video modes without too much anguish.

On the other hand, alternative video modes are rarely supported by off-the-shelf software. Making your favorite spreadsheet or word processor run in an alternative video mode might require you to customize the program's installation process. If you use a VGA clone with a BIOS that supports non-IBM video modes, you might be able to include special drivers provided by the clone's manufacturer when you install your software. Otherwise, you may need to patch an existing driver or write your own driver in order to exploit an alternative video mode.

Nevertheless, there is a reasonable amount of support in the VGA hardware and video BIOS for alternative video modes. If you program the hardware carefully and exploit the services offered in the ROM BIOS, you can run applications with higher resolution or more characters than the usual ROM BIOS video modes provide. ■

Richard Wilton is the author of Programmer's Guide to PC and PS/2 Video Systems *and coauthor of* The New Peter Norton Programmer's Guide to the PC and PS/2, *both published by Microsoft Press. He lives in Los Angeles, California, and he can be reached on BIX c/o "editors."*

OCULUS™ - 10

A real time video digitizer for the VGA adapter.

OCULUS™ - 10 lets you:

- Grab images of moving scenes into your computer
- From all standard cameras and VCR'S
- In either Monochrome or full, true colors
- With VGA resolution

Contrary to competing products which take several seconds to scan an image, **OCULUS™ - 10** grabs images in 1/20th of a second or less. Our software updates them on your VGA board at a rate of up to 10 images per second. **OCULUS™ - 10** gives you full freedom for:

- Digitizing images of live subjects
- Framing
- Focussing
- Selecting scenes from video recordings

Images can be saved in formats compatible with most electronic publishing and graphics software packages.

OCULUS™ - 10! A half-size add-on board for IBM-compatible micro-computers: PC, XT, AT, 386, and PS/2 models 25 and 30. The price? An unbelievable

$495.

To order, fill out
the coupon, or call us:
IN THE US:
800-361-4914
OTHER:
(514) 333-1301
FAX:
(514) 333-1388

Specifications
On-board memory: 128 Kb
A/D converter: flash, 6 bits

FRAME-GRABBING TIMES:

Monochrome:
320 x 200, 4 bits: 1/60 second
320 x 200, 6 bits: 1/20 second
640 x 480, 4 bits: 1/30 second
Color: 320 x 200: 1/20 second

IBM, IBM-PC, XT, AT, PS/2 are trademarks of International Business Machines Corporation.

Circle 60 on Reader Service Card

ACTUAL UN-RETOUCHED PHOTOGRAPHS OF IMAGES GRABBED BY OCULUS™-10

CORECO

**SUPPLIERS OF HIGH QUALITY
IMAGE PROCESSING PRODUCTS
SINCE 1983**

Mail to:

CORECO INC.
6969 Trans-Canada Highway
Unit 113, Saint-Laurent, Quebec, Canada
H4T 1V8

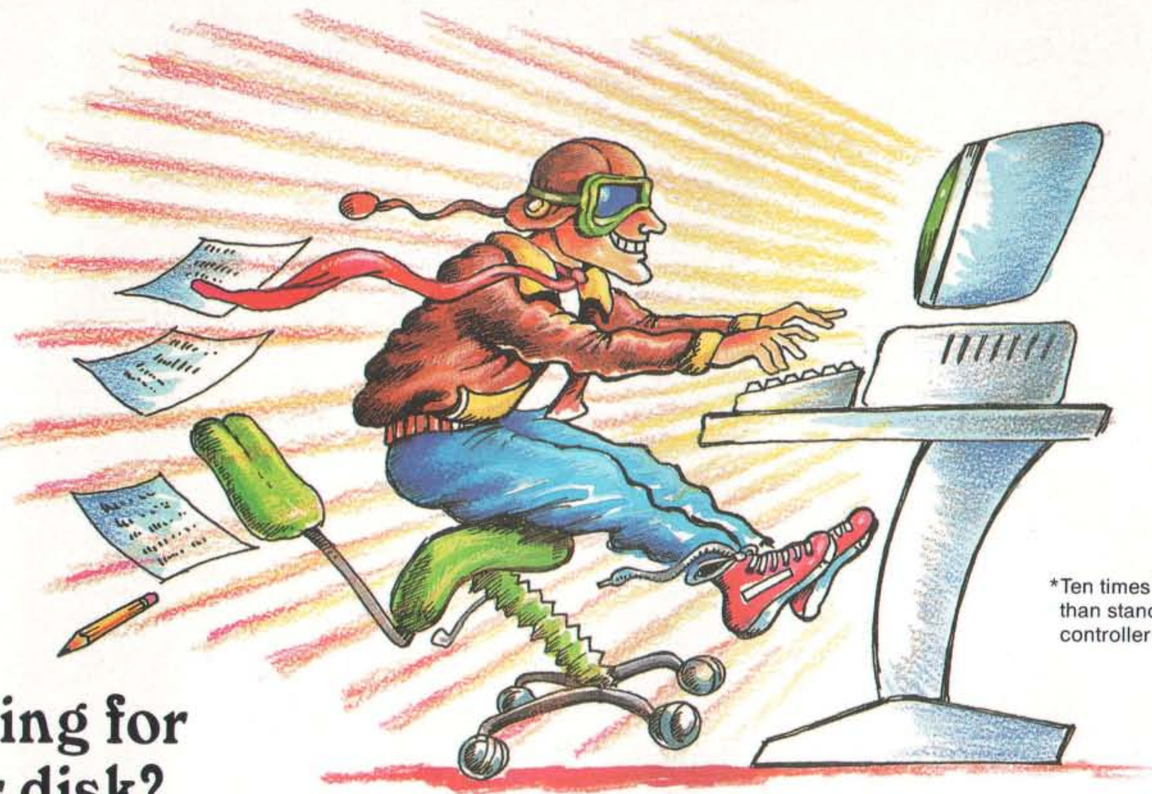
Please rush me an **OCULUS™ - 10** board, with utility software and Coreco's 3 months warranty, for $495 (US currency) plus $15 for shipping.

NAME: ....
ADDRESS: ....
STREET CITY
....
STATE ZIP
PHONE: ....
☐ VISA ☐ MASTER CARD EXP.: ....
CARD # ....
SIGNATURE: ....

How fast is *Fast*?

Ten Times Faster*

KONAN'S TenTime™ Intelligent Caching Disk Controller



*Ten times faster
than standard AT 16 b
controller cards

Waiting for your disk?

The *TenTime*™ Controller eliminates disk bottlenecks.

- Zero Latency Time
- 1 to 1 Interleave
- Elevator Seeks
- Automatic Preread
- Optional Floppy Control

- 10X Faster Access Speed*
- 3X - 10X Faster Throughput
- 4Mb/sec Transfer Rate+
- 16 Bit AT Controller
- On-board Cache Ram
- DOS/Unix Compatible
- Intelligent Cache Routine

+data transfer from controller to PC

See us at
COMDEX/Fall '88
November 14–18, 1988
Bally's Las Vegas
Las Vegas, Nevada
Booth 1137

(goggles not included)

Available for IBM AT, Tandy AT and compatibles

Leading Innovator Since 1978

Circle 124 on Reader Service Card (DEALERS: 125)

KONAN™

1829 West Drake Drive, Suite 103, Tempe, Arizona 85283, FAX 602-345-2829, (602) 345-1300

(602) 345-1300

EXPLORING OS/2 WITH A LISP INTERPRETER

Extensions to XLisp provide a convenient way to experiment with OS/2

Andrew Schulman

Programmers who want to master OS/2's many functions have to write programs that exercise those functions. These folks may find, as I did, that the C compiler and the linker packaged with the OS/2 Software Development Kit (SDK) don't support the kind of interaction with OS/2 that helps novices ascend the long learning curve. Ideally, you want something like a pocket calculator with keys labeled `DOSSLEEP`, `VIOPOPUP`, `KBDSTRINGIN`, and so on; then you could compose expressions using these keys and instantly see the results.

A Lisp interpreter works like that, so I've extended XLisp (David Betz's implementation of Lisp; see "An XLisp Tutorial" in the March 1985 BYTE) to create OS2XLisp, a version of XLisp that runs under OS/2. OS2XLisp is an educational tool that you can use to try out individual OS/2 functions and interactively develop small OS/2 programs.

As its name implies, OS2XLisp requires an OS/2-capable machine and OS/2. Since OS2XLisp is not a bound executable (an .EXE, created by the `BIND` utility, that can run in both protected and real modes), it won't run in the DOS compatibility box.

Hello OS/2 World

At the core of all Lisps, you'll find a read-evaluate-print loop. The interpreter reads each expression that you type, evaluates it, and prints the value of the expression. Since the first program that you write in any language is the one that prints the phrase "Hello world," let's do that program in OS2XLisp. (Note that I'll give the expressions that you type in, followed by OS2XLisp's responses.)

The first version is trivially easy:

```
>"Hello world"
"Hello world"
```

The expression "Hello world" is a string. The OS2XLisp evaluator applies the rule that strings (like characters and numbers) evaluate to themselves and simply returns the string.

Now let's use OS2XLisp with an OS/2 function to print the string "Hello world." You start with `loadmodule`, an OS2XLisp function that returns a handle for a named *dynlink* (dynamic-link) library.

```
>(define viocalls (loadmodule
  "viocalls"))
1360
```

When you type parenthetical expressions like this one, Lisp treats the first object after each left parenthesis as a function call and the rest of the objects as arguments to the function. Every expression returns a value that an enclosing expression can use; Lisp evaluates complex expressions from the inside out. Here, `loadmodule` returns the library handle 1360 to the enclosing `define` expression. The `define` expression creates the variable `viocalls`, assigns the handle to it, and returns the handle as the value of the whole expression. OS2XLisp then prints the value.

Using the handle, you can retrieve the address of an OS/2 function.

```
>(define vio-wrt-tty
  (getprocaddr viocalls
    "VIOWRTTTY"))
15142831
```

The OS2XLisp function `getprocaddr` takes a dynlink handle and the name of a function and then returns the function's address. Now you can use `call`, OS2XLisp's gateway to OS/2, to invoke the function. According to the OS/2 *Programmer's Reference*, the function requires a string, a word specifying the length of the string, and a video handle (a word that is, for now, reserved as zero).

```
>(define hello "Hello world\r\n")
"Hello world\r\n"
```

```
>(call vio-wrt-tty hello
  (word (length hello)) (word 0))
Hello world
0
```

When given a string argument, `length` returns the number of characters in the string. OS2XLisp prefers 4-byte longs,

continued

but `vio-wrt-tty` requires 2-byte words, so you use the OS2XLisp function `word` to cast the arguments to the appropriate size.

The outputs shown come from two different sources. The text comes from OS/2; from Lisp's perspective, it's merely a side effect of the evaluation of the expression. Lisp itself printed the 0, which is OS/2's return code indicating success.

Now you can refine this example by hiding the details inside a Lisp function. Let's define a function `print-str` that prints any string that is supplied as its argument:

```
>(define (print-str str)
   (call vio-wrt-tty str
     (word (length str))
     (word 0)))
PRINT-STR

>(print-str "Hello world\r\n")
Hello world
0
```

continued

Listing 1: *The OS2XLisp* `dir` *function.*

```
; (dir) An OS2XLISP file-listing function.

; usage: (dir [match-str|ext-sym] [print-flag])
; defaults: match-str is "*.*", print-flag is t
; examples:
;     os2xlisp              os/2 equivalent
;
;  -----------------        -------------------
;   (dir)                   c:>dir *.*
;   (dir "*.lsp")           c:>dir *.lsp
;   (dir 'lsp)              c:>dir *.lsp
;   (dir "*.lsp" nil)       none (returns list)

; get handles for OS/2 system calls

(define doscalls (loadmodule "DOSCALLS"))
(define DOSFINDFIRST
  (getprocaddr doscalls "DOSFINDFIRST"))
(define DOSFINDNEXT
  (getprocaddr doscalls "DOSFINDNEXT"))
(define DOSFINDCLOSE
  (getprocaddr doscalls "DOSFINDCLOSE"))

; get handle for C run-time library call

(define crtlib (loadmodule "CRTLIB"))
(define printf (getprocaddr crtlib "_printf"))

; package printf for convenient use

 (defmacro printf (mask &rest args)
    `(c-call printf ,mask ,@args))

; OS/2 file-search structure

;struct FileFindBuf {
; unsigned create_date;
; unsigned create_time;
; unsigned access_date;
; unsigned access_time;
; unsigned write_date;
; unsigned write_time;
; unsigned long file_size;
; unsigned long falloc_size;
; unsigned attributes;
; unsigned char string_len;
; char file_name[13];
; };

; equivalent OS2XLISP structure

(define FileFindBuf
  '((word create_date)
    (word create_time)
    (word access_date)
    (word access_time)
    (word write_date)
    (word write_time)
    (long file_size)
    (long falloc_size)
    (word attributes)
    (byte string_len)
    ((char 13) file_name)))

; print selected elements

(define (print-dir filelist)
  (dotimes (i (length filelist))
    (printf "%-20s %8lu\n"
      (cadr
        (assoc 'file_name (nth i filelist)))
      (cadr
        (assoc 'file_size (nth i filelist))))))

; directory routine

(define (dir &optional filespec (print-flag t))

  (if (null filespec)
    (setf filespec "*.*"))
  (if (not (equal 'STRING (type-of filespec)))
    (setf filespec
      (format nil "*.~A" (symbol-name filespec))))

  (let*
    ((filelist nil)
     (hdir (word -1))
     (attr (word 6))
     (buf (make-struct FileFindBuf))
     (buflen (word (length buf)))
     (find-count (word 1)))

  (if (zerop (call DOSFINDFIRST
     ^filespec
     ^hdir
     attr
     ^buf
     buflen
     ^find-count
     0))

    (progn
      (setf filelist
        (list (unpack-struct FileFindBuf ^buf)))
      (while (zerop (call DOSFINDNEXT
             hdir ^buf buflen ^find-count))
        (nconc filelist
          (list
          (unpack-struct FileFindBuf ^buf))))))

  (call DOSFINDCLOSE hdir)

  (if print-flag (print-dir filelist) filelist)))
```

ler Benz, Stuttgart • Saudi Eastern Petrochemical Company • Global Engineering Ltd. • Chulongkorn University, Thailan
ippine Institute for Development Studies • J. Walter Thompson, Madrid • Institute for Information Industries, Taipei • EPFL, Switzerlan
Volvo • Universidade Nova De Lisboa • Instituto Superior Tecnico, Buenos Aires • UNESCO, Asian Pacific Headquarters

alongkorn University, Thailand • Philippine
ast Broadcasting Corporation • AB Volvo •
i Eastern Petrochemical Company • King
ommunedata, Denmark • University of
apore Polytechnic • Westinghouse • Jet
lobal Engineering Ltd., London • EPFL,
niversitat Stuttgart •
ersity of
borg •
o Indus-
de Peru
OSCH,
ingen-
erhohe
titute
nfor-
on
stries,
ei • The
ry Cor-
tion • AB
• Babcock
Wilcox
onal
Service
e United
s • Tech-
e Universi-
Vienna •

Institute for Development Studies • Kosan-Brunata, Copenhagen
Iberia Airlines • J. Walter Thompson, Madrid • Pierce College
Fahad University of Petroleum and Minerals • Ciba Geigy, Base
California at San Diego • Development Bank of Singapore
Propulsion Laboratories, Pasadena • Farmer's Bank of Swede
Switzerland • Babcock and Wilcox • University of Berge
Jardine Matheson Co
Taiwan Ltd. • Technic
College of Stavanger
Farmer's Bank of Swede
• Norwegian Directorat
of Telecommunications
The United States Pentago
• Daimler Benz, Stuttgart
Universida
de Ingenieri
Lima • Iberi
Airlines • Sau
Eastern Petro
chemical Com
pany • Globa
Engineering Ltd
• Chulalongkor
University, Thailand
• Eurotax Verlagsges
Vienna • Philippine Institut
for Development Studies
• J. Walter Thompson, Madrid

• Technische Universitat, Vienna •
• Saudi Eastern Petrochemical Company •

Universidade Nova De Lisboa • Instituto Superior Tecnico, Buenos Aires • UNESCO, Asian Pacific Headquarter
iversidad de Ingenieria, Lima • Institute for Information Industries, Taipei • Eurotax Verlagsges, Vienna • Daimler Benz, Stuttgart
Fahad University of Petroleum and Minerals • Jet Propulsion Laboratories, Pasadena • Westinghouse • Ciba Geigy, Base

Why do institutions worldwide trust ARC? Before you purchase your next computer, call us. You owe it to yourself to find out.

ARC American Research Corporation

Come see us at COMDEX, 440 West Hall.

(2) 633500
274-8350
967211
(40) 660051
(1) 442-7154

(1) 687699
(2) 852-0232
2421812
(52) 609-100
(2) 396-9900
562459
257-581
(213) 265-0843

(22) 825575
(222) 934212
1681169
(31) 658551
(3403) 90911
(2) 402391
(2) 251-7078
(1) 684-4144

(42) 12560
3826-5007
128-68481
(14) 415-206
(21) 380-2717
(3) 798-2663
297-475
574980

Circle 10 on Reader Service Card (DEALERS: 11)

Of course, you've gone to a lot of trouble to echo a string—something OS2XLisp does quite simply—but it illustrates the method that you use to call any OS/2 function.

A Directory Program

In addition to the command-line-oriented interactions we've seen so far, OS2XLisp supports a file-oriented mode. You can use a text editor to create a file containing definitions of variables and functions. When you start OS2XLisp from the operating system's command line, you can supply the name of such a file; OS2XLisp reads and evaluates the definitions. Or you can load definitions from within the interpreter by using the `load` function.

When you want to explore OS/2 functions that require complicated lists of arguments and to combine those functions algorithmically, you'll prefer text files to typing in definitions at the OS2XLisp prompt. Listing 1 presents one such file, DIR.LSP, which defines the file-listing function `dir`.

The `define` expressions create dynlink handles and, using those handles, addresses for the functions that `dir` will need. The functions come from two different dynlink libraries: OS/2's own DOSCALLS.DLL, and the C run-time library provided with Microsoft C 5.1 (CRTLIB.DLL). Although I've been emphasizing that OS2XLisp can call OS/2 functions, you can use it to call any function exported by a (commercial or homegrown) dynlink library. There's a nice synergy here between Lisp's ability to load functions at run time and OS/2's dynamic linking facility.

The `defmacro` expression encapsulates the function `printf`, exported from the C run-time library, as an OS2XLisp function. From the Lisp perspective, to the symbol `printf`'s function slot (as distinct from its value slot, which retains the address of `_printf` in CRTLIB.DLL) you're binding a function that takes one required argument (the mask, or format string) and a list of subsequent arguments. The body of the function uses the OS2XLisp primitive `c-call` to invoke the compiled function, passing the mask and argument list. (The `,@` directive splices together the mask and arguments to create a single list.) From the OS/2 perspective, note that you're using `c-call` rather than `call`. That's necessary to distinguish between the C calling convention used by the C run-time library and the Pascal calling convention that OS/2 uses.

The `struct FileFindBuf` expression shown in comments (Lisp comments begin with a semicolon) illustrates the C definition of the structure used by the functions `DOSFINDFIRST` and `DOSFINDNEXT`. The next `define` expression creates a similar definition in OS2XLisp. In a C program, you'd declare an instance of the structure like this:

```
struct FileFindBuf dirEntry;
```

After a call to `DOSFINDFIRST` or `DOSFINDNEXT`, you'd retrieve values with expressions like `dirEntry.file_name`.

OS2XLisp can call any function exported by a dynlink library.

In the OS2XLisp `dir` function, you use `make-struct`, a function that analyzes the definition of a structure and creates an object of the appropriate size. On the output end, you use `unpack-struct` to convert the structure into a Lisp association list (a collection of name-value pairs) and `assoc` to convert names to corresponding values. The file STRUCT.LSP, distributed with OS2XLisp, defines the functions `make-struct` and `unpack-struct`.

The calls to `DOSFINDFIRST` and `DOSFINDNEXT` use the `^` macro to take the address of objects, in those cases where OS/2 requires an address. In the case of the strings `filespec` and `buf` (`make-struct` stores the structure that it creates in a string), the address macro is not strictly necessary, since `call` converts strings to their addresses, but it helps to document the kind of arguments that OS/2 expects.

The Lisp function `progn` groups expressions for serial evaluation. The list `filelist`, set to the value returned by `DOSFINDFIRST` (unpacked by `unpack-struct`), grows by destructive concatenation as `nconc` appends to it the results of each call to `DOSFINDNEXT`. When `zerop` ("is-it-zero?") returns false, `DOSFINDNEXT` has failed; `DOSFINDCLOSE` closes the search handle. If `print-flag` is true (as it is by default), `print-dir` uses `dotimes` to iterate over the list, `assoc` to retrieve values from sublists, and `printf` to display them. Voilà! OS2XLisp prints a list of files in the current directory.

Allocating Huge Memory

One of OS/2's more intriguing functions is `DOSALLOCHUGE`, which allocates a sequence of 64K-byte segments and returns a pointer to the first segment's selector. Let's allocate a megabyte of memory.

```
>(define first 0)
0

>(call
  (getprocaddr doscalls
    "DOSALLOCHUGE")
  (word 16) (word 0) ^first
  (word0) (word 0))
; the disk light flashes now
0

>first
863
```

Ignoring the other parameters to `DOSALLOCHUGE`, you asked OS/2 to allocate 16 64K-byte segments and place the number of the first segment in the variable `first`. The 0 returned indicates that `DOSALLOCHUGE` succeeded, the disk activity indicates that OS/2 did some swapping to satisfy your request, and `first` now has the value 863.

You can use OS2XLisp's `lsl` function to verify that `first` refers to a 64K-byte segment. This function corresponds to the 80286 protected-mode instruction LSL; it returns the last legal offset within a memory segment:

```
>(lsl first)
65535
```

So, `first` contains a selector for a 64K-byte segment. What about the other 15 segments that make up your 1-megabyte huge object? The difference between one segment selector and the next is 1, shifted left by the value that `DOSGETHUGESHIFT` returns.

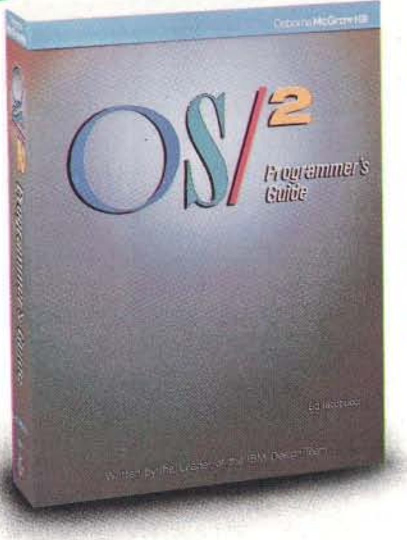
```
>(define shift 0)
0

>(call (getprocaddr doscalls
  "DOSGETHUGESHIFT") ^shift)
0

>shift
4

>(shl 1 shift)
16
```

continued

The OS/2™ Books by The OS/2™ Experts

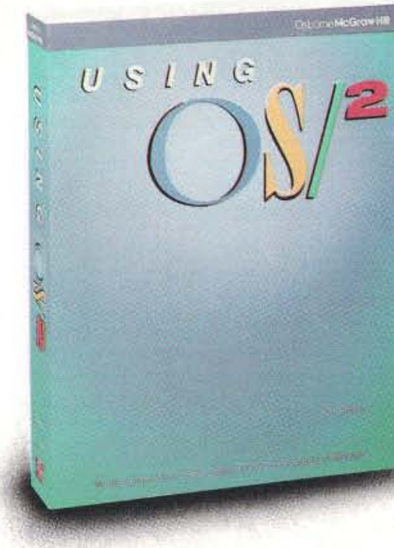
From Osborne/McGraw-Hill

Instant Bestseller
85,000 Copies in Print



According to Bill Gates "Ed Iacobucci was a key architect . . . one of the few individuals who can explain the foundation that OS/2 will provide for the industry . . . what you will read here represents the real ideas behind the operating system and what can be done with it."

From the Foreword of OS/2™ Programmer's Guide



OS/2™ Programmer's Guide

by Ed Iacobucci,
Leader of the IBM®/2 Design Team

Foreword by Bill Gates

Here are the techniques and insights on OS/2 version 1.0 that serious programmers need. Iacobucci discusses

- Dynamic linking and the System API
- Memory management in a protected environment
- OS/2 multi-tasking
- Advanced inter-process communications facilities
- The System I/O capabilities
- Session management, user interface, utilities, and more.

$29.95, *ISBN: 0-07-881300*, 1100 pages

Using OS/2™

By Kris Jamsa,
Author of the National Bestseller
DOS: The Complete Reference

You'll get up to speed on OS/2 with Jamsa's expertise. This quick-paced guide covers fundamental to advanced concepts, illustrated with numerous examples and screen displays. You'll find details on

- Redirection of I/O
- System configuration
- Multi-tasking
- Similarities between DOS and OS/2
- A *complete* command reference with syntax charts that are unavailable elsewhere

$19.95, *ISBN: 0-07-881306-9,* 758 pages

NEW BOOKS on OS/2™

OS/2™ Programming: An Introduction by Herbert Schildt

Provides a solid foundation in OS/2 programming including an introduction to the Presentation Manager graphical interface.

$21.95, *ISBN: 0-07-881427-8,* 500 pp.

Assembly Language Programming Under OS/2™ by William H. Murray, III and Chris H. Pappas

For beginners and pros alike, here's a practical nuts-and-bolts guide to assembly language programming. Features over 100 complete Real and Protected mode programs—a great resource.

$24.95, *ISBN: 0-07-881412-X,* 700 pp.

OS/2™ API: The Pocket Reference by Kris Jamsa

A handy little book that contains all 300 Application Program Interface (API) routines from OS/2.

$5.95, *ISBN: 0-07-881456-1,* 128 pp.

Available at Fine Book Stores and Computer Stores Everywhere

Or Call Our Toll-Free Number ***800-227-0900***
(Mon.-Fri. 8:30 A.M.-4:30 P.M. PST)
Use Your Visa, MasterCard, or American Express

Available in Canada through McGraw-Hill Ryerson, Ltd. Phone 416-293-1911

Osborne **McGraw-Hill**
2600 TENTH STREET
BERKELEY, CALIFORNIA 94710

Trademarks: IBM is a registered trademark of International Business Machines, Inc. OS/2 is a trademark of International Business Machines, Inc.

Circle 163 on Reader Service Card

Listing 2: *Using OS2XLisp to allocate huge memory.*

```
(define (alloc-huge segs &optional (rem 0) (opt 0)
               &aux (seg 0) (shift 0) (lst nil))
  (if (not (zerop (call
          (getprocaddr doscalls "DOSALLOCHUGE")
            (word segs)
            (word rem)
            ^seg
            (word 0)
            (word opt))))
   nil
   (progn
    (call
      (getprocaddr doscalls "DOSGETHUGESHIFT")
        ^shift)
    (setf shift (shl 1 shift))
    (setf lst (list seg))
    (dotimes
      (i (if (zerop rem) (1- segs) segs))
      (nconc lst
        (list (+ seg (* (1+ i) shift)))))
    lst)))
```

Thus, the next segment in the huge object is:

```
>(+ first 16)
879

>(lsl 879)
65535
```

and so on, for all the segments that make up the huge object.

All this can be packaged into a function that allocates a huge object and returns a list of its segment selectors (see listing 2). The first (and only required) argument to `alloc-huge` is the number of segments to allocate. You can easily allocate 512K bytes.

```
>(define big (alloc-huge 8))
(863 879 895 911 927 943 959 975)
```

OS2XLisp returns a list of eight segment selectors. However, 64000K bytes is too much to ask for:

```
>(define impossible
  (alloc-huge 1000))
NIL
```

The `NIL` return signals OS/2's failure to satisfy the request.

One of the optional arguments permits you to allocate a huge object whose final segment isn't a full 64K bytes. For example, you can allocate a huge object made up of four 64K-byte segments and a fifth 1K-byte segment.

```
>(define 1k-bigger
  (alloc-huge 4 1024))
(1927 1943 1959 1975 1991)

>(lsl 1991)
1023
```

The last segment, as `lsl` shows, is indeed a 1K-byte segment.

It's easy to traverse the entire huge object in one operation. In the directory example, you used `dotimes` and `nth` to iterate over a list. Here you'll use `lambda` to create a temporary function that pokes a string into a segment, and you'll use `mapcar` to apply that function to each element of the list `1k-bigger`.

```
>(mapcar
  (lambda (seg)
    (poke
      (mk-fp seg 0)
      (format nil "~A" seg)
      'str))
  1k-bigger)
```

The `mk-fp` function manufactures a far pointer from a segment and an offset; `format` (a Lisp `printf` analog) builds a string containing the segment selector; `'str` specifies that the object being poked is a string; `poke` puts the string into the segment.

The following verifies that you have really poked data into the object:

```
>(mapcar
  (lambda (seg)
    (peek
      (mk-fp seg 0)
      'str))
  1k-bigger)
("1927" "1943" "1959" "1975"
 "1991")
```

Last, you need a function to release a huge object. You can let it work on the entire list or just the first segment.

```
>(define (free-huge seg)
  (zerop (call
    (getprocaddr doscalls
      "DOSFREESEG")
      (word (if (listp seg)
        (car seg) seg)))))
FREE-HUGE
```

After you free a segment, its size becomes zero. If you then try to read or write into the segment, you'll see what's meant by "protected mode":

```
>big
(863 879 895 911 927 943 959 975)

>(lsl 863)
65535

>(free-huge big)
T

>(lsl 863)
0

>(poke (mk-fp 863 0) "Hello, big?")
break: Segmentation Violation
```

The segmentation violation doesn't trigger a return to OS/2, by the way, as it would in most OS/2 applications. OS2XLisp keeps control, and you can proceed.

An OS/2 Laboratory

If you're running OS/2 but don't have Microsoft's SDK, OS2XLisp can give you a preview of what it's like to program under OS/2. If you already own the SDK, OS2XLisp can still be an alternative to compiling and linking C programs.

Lisp's interactive style makes it easy to try out OS/2 functions singly or in combination. The OS/2 dynlink facility merges nicely with Lisp; you can write Lisp functions that make calls to OS/2 functions, to functions in the C run-time library, or to functions in any .DLL file that you create under OS/2. ■

Editor's note: *Source code and documentation for OS2XLisp are available in a variety of formats. See page 3 for details.*

Andrew Schulman is a software engineer at Meta Software in Cambridge, Massachusetts. He can be reached on BIX c/o "editors."

Receive a FREE* SIVA 386 SYSTEM

with the purchase of $2995++ of software or $4995++ of hardware.

Standard 386 Features:

- 32-bit Intel 80386-16 CPU.
- 1MB of 32-bit RAM on board. System expandable to 16MB.
- 8/16/20 MHz Keyboard selectable.
- ST-251-1 Seagate 40MB Formatted 28 ms high speed, with ultra high speed Controller 1:1 interleave.
- 1.2MB High Capacity Floppy Drive.
- Super deluxe heavy duty tower case with 6 half-height drive openings.
- High-resolution 12" Non-Glare Amber Display. Tilt and Swivel base, Hercules-compatible Adapter.
- 101 Key Enhanced Keyboard, Pleasant "Tactile/Click" Feel.
- 80287/387 Math-Coprocessors optional.
- Fully compatible with virtually all XT/AT and 386 software.

Upgrades for your FREE 386 System:

- VGA Color Upgrade — add only $495.
- 20 MHz CPU Upgrade — add only $195.
- Call for all other options and upgrades.

Choose Your Hardware

A hardware purchase of $4995 or more is required to receive the SIVA 386 System FREE.

• QMS PS 800II Postscript Laser Printer	$5995
• QMS PS 810 Postscript Laser Printer	$4995
• CDC WREN IV 300MB SCSI Hard drive with Controller	$2595
• CDC WREN III 155MB SCSI Hard drive with Controller	$1795
• CDC WREN II 86MB ST506 Hard drive with HD/FD Controller	$ 895
• Eight Port RS232 Intelligent Card with Xenix Driver	$ 995
• 32-Bit 8MB Memory Expansion Board	$2997
• Intel 80387 — 16 Coprocessor	$ 495

Software

• Complete SCO Xenix System (including Operating System, Developing System and Text Processing System for 80386-based System)	$1595
• SCO Lyrix System	$ 595
• SCO Professional	$ 895
• SCO Integra	$1295
• SCO Foxbase Plus	$ 995
• SCO VP/IX (integrated DOS environment — two users)	$ 495
• Language & Development Tools	CALL
• Networking & Communication Packages	CALL

A software purchase of $2995 or more is required to receive your FREE SIVA 386 System. Mix and match to meet your needs!

Prices are for Industry Standard 80386-based Computers. For all other systems and items please call:

1-800-252-4212

VNS America Corp.

Suite 270, 910 Boston Post Road
Marlboro, Massachusetts 01752 U.S.A.
In Massachusetts 508-460-0016
FAX: 508-481-2218

*Offer good until December 31, 1988.

Circle 248 on Reader Service Card

• SCO is a trademark of The Santa Cruz Operation, Inc. • XENIX is a registered trademark of Microsoft Corporation. • VP/ix is a trademark of INTERACTIVE Systems Corporation.
• PS/2, XT and AT are trademarks of IBM Corporation. Prices are subject to change without notice. Call for complete warranty details.

BYTE's Subscriber Benefits Program

Your BYTE subscription brings you a complete menu of the latest in microcomputer technology every 30 days. The kind of broad-based objective coverage you read in every issue. *In addition*, your subscription carries a wealth of other benefits. Check the check list:

BONUSES

☑ ***Annual Separate Issues:*** In addition to BYTE's 12 monthly issues, subscribers also receive our annual IBM PC issue free of charge, as well as any other annual issues BYTE may produce.

☑ ***BYTE Deck:*** Subscribers receive five BYTE postcard deck mailings each year—a direct response system for you to obtain information on advertised products through return mail.

☑ ***Reader Service:*** For information on products advertised in BYTE, circle the numbers on the Reader Service card enclosed in each issue that correspond to the numbers for the advertisers you select. Drop the post-paid card in the mail and we'll get your inquiries to the advertisers.

☑ ***TIPS:*** BYTE's Telephone Inquiry System is available to subscribers who need *fast response* from advertisers. After obtaining your Subscriber I.D. Card, dial TIPS and enter your inquiries. You'll save as much as ten days over the response to Reader Service cards.

☑ ***Free Programs Via BYTEnet:*** You get access to the BYTEnet Bulletin Board Service, which allows you to download, via modem, valuable program listings. There is no connect charge for this service.

☑ ***Subscription Service:*** If you have a problem with, or a question about your subscription, you may call our service department toll-free at 800-423-8272 (in New Jersey call 800-367-0218) during regular business hours (Eastern Time). You can also use Subscription Service to obtain back issues. Should you care to correspond, use the following address: P.O. Box 6821, Piscataway, N.J. 08855.

☑ ***Editorial Indices:*** Available through our customer service department P.O. Box 328, Hancock, New Hampshire 03449.

PAID SERVICES

☑ ***BIX:*** BYTE's Information Exchange puts you on-line 24 hours a day with your peers via computer conferencing and electronic mail. All you need to sign up is a microcomputer, a modem, and telecomm software. For further information and cost, call 1-800-227-BYTE.

☑ ***Program Listings:*** Listings of programs that accompany BYTE articles are now available on BIX, on disks or in quarterly printed supplements (see reply cards in this issue for cost information), or call 1-800-258-5485.

☑ ***Microform:*** BYTE is available in microform from University Microfilm International in the U.S. and Europe. See Contents page for cost information.

DISCOUNTS

☑ One-year subscription at $22.95

☑ Two-year subscription at $39.95

☑ Three-year subscription at $55.95

☑ One-year group subscription for ten or more at $18.95 each. (Call or write for details.)

TOLL-FREE NUMBERS FOR YOUR CONVENIENCE:

Subscriptions & Back Issues:
1-800-423-8272
(in N.J., 1-800-367-0218)

BIX: 1-800-227-BYTE

Program Listings Orders:
1-800-258-5485

BYTE

It's indispensable.

BEST OF BIX

Comments, cures, comfort, and assistance for users of IBM and compatible systems

Several of the hundreds of conferences on BIX (the BYTE Information Exchange) deal with IBM computers and the software that runs on them. We've culled the following messages from recent discussions in the IBM PC AT, MS-DOS, PS/2, and OS/2 conferences of BIX. The topics range from installing hardware and using application programs to in-depth discussions of technical tricks and traps.

IBM PC AT

INTERNAL/EXTERNAL MODEMS

ibm.at/hardware #3032, from jfrickson (John Frickson).

I have two questions I hope some of you BIXen can answer for me.

1. I recently inherited a Hayes internal 1200-bps modem. The catch is, I have no manual. So, could someone explain the settings? There is a switch block with three switches, a three-position jumper, and a two-position jumper. What do they all do?
2. I also have a multifunction card that came with my computer (a Quantus AT clone). The documentation for this card that was sent with the computer is the wrong documentation. When I recently tried to contact the manufacturer, I was told they were out of business (so much for my 3-year warranty!). Anyway, the card appears to be a DTK 286 Courier I/O II card with two serial ports and a game port.

I have been using COM1, which is a DB-9 connector, for some time now, but I have been unable to get COM2 to work. There are half a dozen jumpers on the card, but no configuration I try gets COM2 to work. Does anyone know anything about this card?

ibm.at/hardware #3038, from jfleming (Jon Fleming). A comment to message 3032.

Did you ever have COM2 working on this card? Most cards that include provisions for two serial ports come with an empty DIP socket into which you must plug an 8250 UART to get COM2 to do its thing-although for an AT you might want a 16450 or 16550A. Perhaps some more hardware-oriented type can come up with more suggestions.

ibm.at/hardware #3040, from jfrickson. A comment to message 3038.

The card has an 8250 plugged into a socket (it was ordered with two COM ports). But when I connect my modem up to the COM2 port, the lights look funny. I don't remember offhand, but I think carrier detect and another light were on. Whichever they were, it didn't look normal and the modem wouldn't respond. The lights on the modem changed when I tried different jumper configurations, but I could never get the thing to work right.

ibm.at/hardware #3042, from bredd (Brandt Redd). A comment to message 3040.

What does the socket for the second port look like? Often on cards like that, the bracket contains a male DB-9 connecter, which is COM1, and a female DB-25 connecter, which is a parallel printer port. The second serial cable is usually obtained on a male DB-25 connecter, which has a short ribbon cable connecting to pins on the card. If this is really a parallel port, it would explain the funny light pattern on the modem.

ibm.at/hardware #3050, from jfrickson. A comment to message 3042.

The bracket for this card has a male DB-9 connector and a female DB-25 connector. There is also a second bracket with a female DB-15 connected to a pin connector on the card (I think this is a

continued

game port). Also on the card is a 10-pin connecter, but I received nothing to attach to this. Could this be the connector for COM2?

As I believe I mentioned earlier, the board seems to have all the parts necessary for two COM ports. It has an 8250 in a socket. Also in sockets are two chips labeled:

NC1488N VE321
+18317 DS1489N NC1489P

So, am I right in assuming that the card has everything necessary for two serial ports, but that I need a 10-pin-to-DB-25 ribbon cable? If so, where can I get such a cable?

ibm.at/hardware #3052, from irae (Ira Emus). A comment to message 3050.

The DB-9 is probably COM1. The DB-25 is a printer port, and the DB-15 is almost certainly a game port, which leaves that 10-pin connector as COM2: You will need a header to DB-9, although in mine, I use a DB-15 and just ignore the extra six pins. Ugly, but it works.

ibm.at/hardware #3058, from bredd. A comment to message 3052.

That sounds right. I assume that there is another 8250 that is soldered in. In any case, if there are two serial ports, there will be two 8250s. I would guess that you'll need to contact your distributor about the 10-pin-to-DB-25 (or DB-9) connector or find someone to build it for you. (pause) I just took a look at ours, and the cable swaps pins as follows:

10-pin	DB-25
1	8
2	3
3	2
4	20
5	7
6	6
7	4
8	5
9	21

This is on a machine from PC's Limited. Your pin-out may vary. Incidentally, the pin numbers on the 10-pin end correspond exactly with the pin numbers on a DB-9, which would imply that you could connect a DB-9 to one end of a ribbon cable and the 10-pin connector to the other. There is only one problem with this-the pins are numbered differently:

DB-9	10-pin
1 2 3 4 5	1 3 5 7 9
6 7 8 9	2 4 6 8 10

ibm.at/hardware #3061, from jfrickson. A comment to message 3052.

I hooked up my printer to the DB-25, and guess what? It's LPT2! So it looks like I got a second parallel port I didn't ask for (though I won't complain about it :->) and a second serial port if I can figure out how to connect it up.

ibm.at/hardware #3062, from jfrickson. A comment to message 3058.

I don't recall seeing another 8250. jfleming mentioned earlier (msg. 3038) 16450 or 16550A chips. The 8250 is socketed, so I assume it's for COM2. There are several chips soldered in, one of which could be either an 8250 or a 16x50. I'll check it out for sure when I get a chance. But it appears that I have two serial ports (one connector there, and one I have to wire up) and a parallel port.

USING EXTRA MEMORY

ibm.at/hardware #3063, from dhudes (Dana Hudes).

We got some ATs in at work. They are connected via ARCnet and Novell SFT 2.1 to an 80386 server. The ATs have 1 megabyte of physical RAM. With DOS 3.3 and Novell, we end up with about 460K bytes of RAM left. Is there a way to make any use of the memory we have above 640K bytes? A RAM disk isn't terribly useful since these machines have 40-megabyte hard disk drives and the server has 140 megabytes. I doubt it would be a large-enough RAM disk for the temporary files from a C compile (we have Microsoft C 5.1 and Archimedes C-8051).

How can we get back or otherwise increase the free RAM while maintaining our network connection (I can get just under 100K bytes back by removing the TSRs that handle the network)?

It is my understanding that EMS memory can only be used by software written to take advantage of it. Is this correct? Also, I thought someone had a board that expanded your memory to 720K bytes or something like that. These ATs have only Hercules (clone) cards for display adapters. That frees up the rest of the memory reserved for display adapters.

I realize that various portions of the region from 640K bytes to 1 megabyte are reserved for various things, most of which I suspect we don't have.

ibm.at/hardware #3064, from rbrukardt (Randall Brukardt). A comment to message 3063.

It is possible to get boards that allow the use of 704K bytes in DOS. These boards map memory into the unused (if you are using MDA, Hercules, or CGA) A000 bank of memory. There is a public domain program called 704K that allows that 64K bytes to be added to DOS. Several very old memory boards have that capability, and that is what I've been using on our machines (mainly our old Seattle Computer PC memory boards). The only new board I've been able to dig up that does that is the JRAM-3 board. But there must be others. (We don't like our JRAM-3 much.)

ibm.at/hardware #3065, from feenberg (Daniel Feenberg). A comment to message 3064.

MAXIT and HiCard are two memory cards that allow 704K bytes of DOS-usable memory in an XT or AT with a Hercules or monochrome card. You get 736K bytes with a CGA and no extra with an EGA. Even with an EGA, they do allow TSRs to run *above* the display adapter, which can be nice. There is a thread in this conference (beginning with msg. 827) that discusses these cards.

ibm.at/hardware #3066, from dnanian (David Nanian). A comment to message 3065.

You can do it with a RAMpage board, too. You just map the memory there and write a small interrupt handler that removes those page-frame areas from the mapping table.

80287 COPROCESSORS

ibm.at/hardware #3070, from rgrenader (Robert Grenader).

I'm confused. I've got an AT clone that runs at 12.5 MHz. Which 80287 is required? The 10-MHz, or 8, or what?

continued

Compuclassics

WE WELCOME INTERNATIONAL ORDERS

1 818 705-4885 FAX

NEW LOW PRICES

SOFTWARE

ALDUS	
Pagemaker 3.0	539.00
AMERICAN SMALL BUSINESS	
Design Cad	159.00
Design Cad 3D	159.00
ASHTON TATE	
Multimate II	279.00
Dbase III Plus	395.00
Rapidfile	195.00
Framework II	429.00
Chartmaster	229.00
Master Graphics	299.00
ASK SAM SYSTEM	
Ask Sam	235.00
AUTODESK	
Autosketch Enhanced	65.00
BLOC DEVELOPMENT	
Formtool W/Greatest Hits	59.00
BOEING COMPUTER SERVICES	
Boeing Graphics (3D Color)	209.00
BORLAND	
Sprint	125.00
Sidekick	55.00
Sidekick Plus	125.00
Eureka	99.00
Quattro	149.00
Turbo Database Toolbox	62.00
Turbo Graphix	62.00
The Developer's Library	235.00
Turbo Lightning	62.00
Reflex	90.00
Superkey	62.00
Turbo Prolog	62.00
Turbo Basic	62.00
Turbo C	62.00
Paradox V 2.0	429.00
Turbo Pascal 4.0	62.00
Turbo Tutor 4.0	45.00
BREAKTHROUGH	
Timeline V 3	339.00
BRODERBUND	
Print Shop	35.00
Memory Mate	45.00
BUTTONWARE	
PC File +	45.00
CENTRAL POINT	
Copy II PC	25.00
Copy II PC Option Brd Dlx	109.00
PC Tools Deluxe	39.00
COMPUTER ASSOCIATES	
Supercalc IV	299.00
Superproject Expert	445.00
ACCPAC BPI	275.00
Silverado	99.00
CONCENTRIC DATA SYSTEMS	
R & R Relational Report	109.00
CORE INTERNATIONAL	
Corefast	89.00
DAC	
Easy Accounting 3.0	59.00
Easy Payroll 3.0	59.00
Bonus Pack 3.0	115.00

UTILITIES	
Org Plus	59.00
1 Dir PLUS	55.00
Duet	49.00
Direct Access	55.00
Grammatik III	55.00
X Tree	37.00
X Tree Pro	69.00
Sideways	40.00
Max Think	45.00
Tornado	59.00
Graph-In-The-Box	55.00
Mace Utilities	55.00
Norton Utilities	50.00
Norton Utilities Advanced	79.00
Norton Commander	49.00
Disk Technician	59.00
Disk Technician Plus	79.00
Copywrite/Zerodisk	CALL
Desqview 2.01	75.00
Rightwriter	59.00
Mirror II	35.00
Flash 5.6	49.00
Q & A 3.0	199.00
Laplink Plus	85.00
Note-It-Plus	49.00
SQZ Plus	59.00
Cambridge Spreadsheet Analyst	89.00
The Documentor	179.00
dFlow	89.00

DATASTORM	
Procomm Plus	52.00
DBFAST	
Dbfast	62.00
DIGITAL RESEARCH	
Gem Desktop	32.00
Gem Draw Plus	179.00
Gem 1st Word Plus	115.00
Gem Word Chart	115.00
Presentation Team	285.00
Desktop Publisher	179.00
DIGITALK	
Smalltalk V	75.00
Smalltalk V 286	145.00
FIFTH GENERATION	
Fastback	79.00
Fastback Plus	99.00
FOX SOFTWARE	
Foxbase Plus	199.00
Foxbase Multi-user	299.00
Foxbase Runtime Unlimited	265.00
GENERIC SOFTWARE	
Generic Cad 3.0	55.00
Dot Plot	27.00
Auto Convert	27.00
Auto Dimension	27.00
3D Solid Modeling/Rendering	179.00
GIBSON TECHNOLOGY	
Spinwrite	55.00
GOLDEN BOW	
V Feature Deluxe	125.00
V Cache	45.00
HAVENTREE	
Interactive Easyflow	129.00
HAYES	
Smartcom III	149.00
HILGRAEVE	
Hyper Access	89.00
IBM	
Displaywrite IV	299.00
DOS 3.3	95.00
LATTICE	
Lattice C Compiler	229.00
LEADING EDGE	
Word Processor W/Spell/Merge	59.00
Word Processor V1.5	89.00
LIVING VIDEOTEXT	
Grandview	159.00
LOTUS DEVELOPMENT	
ALL PRODUCTS	CALL
MATHSOFT	
Mathcad 2.0	225.00
MECA	
Managing Your Money 4.0	125.00
MERIDIAN TECHNOLOGY	
Carbon Copy Plus	115.00
MICROGRAFX	
Designer	465.00
MICROLYTICS	
Gofer	42.00
MICROPRO	
Wordstar Professional	249.00
Wordstar 2000 Plus	239.00
MICRORIM	
Rbase for Dos	475.00
MICROSOFT	
Pageview	35.00
Quick C	67.00
Word	225.00
Quickbasic	67.00
C Compiler	299.00
Fortran Compiler	299.00
Cobol Compiler	599.00
Macro Assembler	99.00
Learning DOS	35.00
Flight Simulator	35.00
Excel	309.00
Windows 386	129.00
PC Works	129.00
MICROSTUF	
Crosstalk XVI	99.00
Crosstalk Mark 4	125.00
MIGENT	
Ability Plus	145.00
NANTUCKET	
Clipper	439.00
NASHOBA	
Nutshell Plus	159.00
NORTH EDGE SOFTWARE	
Timeslips III	115.00
PAPERBACK SOFTWARE	
VP Info	65.00
VP Planner	55.00
VP Planner Plus	95.00
PATTON & PATTON	
Flowcharting II Plus	145.00
PC SUPPORT GROUP	
Lightning	55.00
Lucid 3D V 2.0	89.00
PEACHTREE	
Complete Accounting II	159.00
PERSOFT	
Smarterm 240	209.00
Referee	45.00
SANTA CRUZ OPERATION	
Xenix 286 Operating Sys	439.00
Xenix 286 Developement Sys	439.00
Xenix 386 Operating Sys	509.00
Xenix 386 Developement Sys	509.00
SCITOR	
Project Scheduler Network	365.00
SIMON & SCHUSTER	
New World Writer II	99.00
Typing Tutor IV	32.00
SOFTLOGIC SOLUTIONS	
Disk Optimizer	42.00
Cubit	42.00
Double DOS	42.00
@ Liberty	115.00
Magic Mirror	59.00
SOFTWARE PUBLISHING	
PFS First Publisher	79.00
Professional Write	119.00
Professional File	179.00
PFS Professional Plan	59.00
PFS First Choice	89.00
Harvard Total Project II	379.00
Harvard Graphics	299.00
STORAGE DIMENSIONS	
Speedstor	49.00
TRANSEC SYSTEMS	
Masterkey Unlock	109.00
dAnalyst	135.00
TURBO POWER	
TDebug	35.00
Turbo Professional	65.00
UNISON WORLD	
Printmaster Plus	32.00
Art Gallery I & II & III (Each)	19.00
Newsmaster II	49.00
WISEWARE	
Prime Time	65.00
WORD PERFECT CORPORATION	
Word Perfect 5.0	239.00
Word Perfect Network Server	349.00
Word Perfect Network Add-On	75.00
Plan Perfect	195.00
Data Perfect	299.00
Word Perfect Executive	125.00
Word Perfect Library	65.00
WORD TECH	
DBXL Diamond	115.00
Quicksilver Diamond	345.00
XEROX	
Ventura Publisher 1.1	519.00

HARDWARE

ARRAY TECHNOLOGIES (ATI)	
VIP VGA	279.00
EGAWonder	189.00
AST RESEARCH	
Advantage Premium 512K	379.00
Six Pack Plus 384K	269.00
Six Pack Premium 256K	269.00
Rampage AT 512K	439.00
AST 5251/11 Enhanced	579.00
Hot Shot 286	395.00
ATD ZUCKER	
Monographics Short Card	79.00
Memory Expansion 384K	219.00
Modular I/O Bare P/S/Clock	75.00
Clock Board Standalone	35.00
1200 Baud Internal Modem	85.00
CITIZEN	
120D	159.00
MSP 40	349.00
MSP 15E	359.00
MSP 50	445.00
COMPUTER ACCESSORIES	
P15 Power Director	99.00
EVEREX	
EV 1800 8MHZ AT System	985.00
EV 1800 10MHZ AT 0 Wait	1249.00
Evercom II 1200 Modem	75.00
Evercom III 2400 Int Modem	155.00
Magic I/O For AT	59.00
RAM 3000 EMS Expansion	99.00
FIFTH GENERATION	
Logical Connection 256K	379.00
HAYES	
Smartmodem 1200	299.00
Smartmodem 1200B W/Software	299.00
Smartmodem 2400	465.00
Smartmodem 2400B W/Software	465.00
HERCULES	
Hercules Monochrome Plus	189.00
HEWLETT PACKARD	
Laserjet II	1849.00
Fonts/Cartridges for Laserjet II	CALL
INTEL	
Above Board PC 64K	269.00
Above Board 286 W/512K	369.00
8087-3 (5MHZ)	109.00
8087-2 (8 MHZ)	159.00
80287 (6 MHZ)	175.00
80827 (8 MHZ)	250.00
80287 (10 MHZ)	319.00
Inboard 386 PC or 386 AT	1099.00
1 MB Exp for 386 Inboard	675.00
INTERNATIONAL BATTERY	
AT Replacement Battery	19.50
AST Six Pack Battery	3.50
IRWIN MAGNETICS	
120 XT 20MB Internal	339.00
125 AT 20 MB Internal	339.00
KENSINGTON	
Masterpiece	89.00
Masterpiece Plus	105.00
Masterpiece Remote	115.00
LOGITECH	
Logimouse C7	75.00
Logimouse Hi Rez	99.00
Logimouse C7 + Paintbrush	95.00
Logimouse W/Cad/Paint	125.00
Publisher Mouse	125.00
MICROSOFT	
BUS Mouse W/Paintbrush	109.00
BUS Mouse W/Windows	145.00
Serial Mouse W/Paintbrush	109.00
Serial Mouse W/Windows	145.00
MICROSPEED	
Fast Trap	95.00
MIGENT	
Pocket Modem	115.00
MOUSE SYSTEMS	
PC Mouse BUS Plus	95.00
PC Mouse Serial Plus	95.00
NEC HOME ELECTRONICS	
Multisync II	629.00
NEC INFORMATION SYSTEMS	
P 2200 80 COL	379.00
P5200	589.00
P5300	769.00
PANASONIC	
KX-P1091I	209.00
KX-P1595	479.00
KX-P1524	649.00
KX-1092I	365.00
PARADISE	
Autoswitch 480	169.00
VGA Plus	279.00
PLUS DEVELOPMENT	
Hardcard 20 MB	569.00
Hardcard 40 MB	709.00
POLAROID	
Polaroid Palette	1499.00
Polaroid Palette Plus	2399.00
PRACTICAL PERIPHERALS	
Practical Modem 1200 Internal	69.00
Practical Modem 1200 SA	109.00
Practical Modem 2400 INT	155.00
Practical Modem 2400 SA	185.00
SAMSUNG	
Amber Monitor	85.00
SEAGATE TECHNOLOGY	
ST 251 40MB No Controller	389.00
ST 225 20MB W/Controller	295.00
ST 238 30MB W/Controller	319.00
ST 251-1 No Controller	445.00
SUMMAGRAPHICS	
Summasketch 1201 Plus	389.00
SYSGEN	
Ext 5¼'' Drive	289.00
TOUCHBASE	
Worldport 2400 Modem	269.00
Worldport 1200 Modem	159.00
TOSHIBA	
T 1000 Laptop	875.00
T 3100-20 Laptop	3415.00
P321 SL Printer	549.00
P341 SL	759.00
P351 SX	1175.00

ADVANTAGES

- Orders placed before 3 p.m. (PST) shipped same day
- We welcome corporate accounts
- Immediate replacement of defective goods.
- Bulk discounts
- Immediate shipment on purchase orders from qualified institutions (schools and universities included)
- No hidden charges.

TERMS:

All prices are subject to change without notice. We do not guarantee compatibility. No surcharge for VISA or MasterCard. 2% surcharge American Express. No returns without RA#. Short shipments must be notified within 48 hours. 15% restocking fee on non-defective goods: $3.50 C.O.D. charge. Shipping $4.50 minimum per item, less on bulk orders. ($8.50 Blue Label.) (Higher for some software or hardware items.)

Call for prices for any software item not included in this price list.

Order desk & technical support open
8 a.m. to 6 p.m. Monday-Friday
10 a.m. to 2 p.m. Saturday (PST)

P.O. BOX 1588
6934 Canby St., Suite #109-110
Reseda, CA 91335
Telex 292415COMPU UR/Fax 818-705-4885

WE WELCOME INTERNATIONAL ORDERS

1 818 705-1895 US **1 800 231-6603 CA** **1 800 328-4473 US**

Circle 252 on Reader Service Card (DEALERS: 253)

ibm.at/hardware #3071, from blaszczak (Michael Blaszczak). A comment to message 3070.

When you drop any 80x87 chip into your system, that math processor must only be rated at *two-thirds* the speed of the CPU.

Since I have an 8-MHz PC's Limited, I need a 6-MHz 80287.

Since you have a 12.5-MHz CPU, you'd need an 8.33-MHz 80287. I would bet that you could get by with an 8-MHz part.

Be wary of dealers who tell you otherwise!

MS-DOS

DOS 4.0

ms.dos/other #1309, from sfulk (Steven Fulk).

Today, IBM very quietly introduced DOS 4.0 and OS/2 Extended Edition 1.0. The highlights, according to the literature, are as follows:

DOS 4.0 supports all members of the IBM PS/2 and PC families (except PCjr, XT/370, and AT/370) and is upward-compatible with DOS 3.30.

DOS 4.0 provides a new program warranty with defect service for 1 year.

DOS 4.0 supports large hard disk files greater than 32 megabytes in a nonpartitioned manner. The new addressing format of 32-bit versus 16-bit removes the limitation of 32-megabyte DASD partitions. However, it can install on and utilize currently formatted hard drives.

The DOS 4.0 shell provides program, file, and directory services as user-friendly alternatives to the command line. This shell is similar in appearance to the OS/2 Presentation Manager. Apparently, any user actions are accomplished from selection from a menu with mouse or keyboard. The installation of this shell is optional.

DOS 4.0 provides support for LIM/EMS 4.0. Expanded memory is addressed through a combination of an EMS device driver and an IBM adapter capable of expanded memory.

A full-screen installation utility, called SELECT, is provided to simplify the installation of DOS 4.0. AUTOEXEC and CONFIG.SYS files are automatically generated.

DOS 4.0 provides support for a text-mode (versus graphics) command-line display interface when not using the shell. DOS 4.0 supports greater than 25 lines of text on those EGA and VGA displays with that capability. The GRAPHICS and GRAFTABL commands have been enhanced.

Many of the other DOS commands, such as ANSI.SYS, APPEND, BACKUP, BUFFERS, CHKDSK, COUNTRY, DEBUG, DISPLAY.SYS, ERASE, FASTOPEN, FDISK, FORMAT, KEYB, MEM, MODE, PRINTER.SYS, REM, REPLACE, SYS, TREE, and VDISK, have been enhanced. DOS 4.0 will list for $150.

ms.dos/other #1311, from jfachini (John Fachini). A comment to message 1309.

Oh yea. Any chance (even small?) of upgrades? Upgrades–we don't give no stinkin' upgrades!

ms.dos/other #1312, from cosby (Steve Cosby). A comment to message 1309.

So, is it worth buying to run on a non-IBM clone? Or has IBM installed enough IBM specifics to thwart that?

ms.dos/other #1313, from jbc.tangram (James Casler). A comment to message 1311.

>Upgrades

You can get an upgrade to IBM PC-DOS (not MS-DOS) through one of two means. If you bought it at a computer store, ask your dealer for the upgrade form. You have to mail it to IBM in Connecticut. Or, if you got it through an IBM branch, you can send the form to them. Upgrades for DOS 4.0 will be $90 (I think). Lots of other IBM PC-DOS programs have been upgradable this way, but I don't think dealers explain this. We get our info from IBM electronically via our branch, and the announcements always have upgrade info in them.

ms.dos/other #1314, from rduncan (Ray Duncan). A comment to message 1309.

>in a nonpartitioned manner

Well, not exactly. MS-DOS 4.0 defines a new type of partition. A driver that knows how to read/write that partition uses 32-bit sector numbers in the request headers from the kernel for read and write operations. Also, the BPB (BIOS Parameter Block) for such partitions is extended, and Int 25h and 26h operations directed to the logical units represented by the new partition type use a different parameter-passing scheme.

In other words, you can SYS MS-DOS 4.0 onto an existing hard disk, and nothing special will happen. To take advantage of the new partition type, you'd have to back up your hard disk, delete the old partitions, declare a new "huge" partition, then restore the files into the new partition. Or you could leave your existing primary partition alone, delete the DOS 3.3-style "extended partition" containing multiple logical drives, and replace the extended partition with a new huge partition.

MS-DOS 4.0 uses EMS for the disk cache (BUFFERS=) and for the FASTOPEN name/extent cache. It does this via the Int 67h interface of the EMS memory manager. There is no change in the definition of the EMS interface to application software, and MS-DOS 4.0 doesn't add anything in the way of new EMS capabilities.

ms.dos/other #1315, from jfachini. A comment to message 1313.

This thing's gonna run on my ALR 386, right?

ms.dos/other #1316, from jbc.tangram. A comment to message 1315.

It certainly might. With PC-DOS it mostly matters how compatible to "blue" your BIOS is. I could believe that the IBM EMS may not, but the new large disk partitions and the character shell should work.

continued

NATURAL LANGUAGE INTERFACE

THE COMPUTER CHRONICLES MAKES KEEPING UP WITH THE INFORMATION AGE EASY

Stewart Cheifet and Gary Kildall are your co-hosts for a weekly half-hour television program aimed at computer users, owners, educators and computer industry professionals. If you're looking for help in finding out what's new and what's news, tune in to THE COMPUTER CHRONICLES every week on your local public television station.

Regular commentators are Jan Lewis, President of Lewis Research Corporation and publisher/editor of HyperAge magazine, and George Morrow, founder of Morrow Designs.

JAN LEWIS

GEORGE MORROW

Topics this season include: CD ROMS — Shareware — Multitasking — Business Graphics — Investment Software — PC Imaging — PC Networks — Decision Support Software — Laser Printers — Hypercard — Input Devices — and MUCH MORE.

Each week THE COMPUTER CHRONICLES looks at the top stories of the week in Random Access, a news segment designed to keep you informed about the latest developments in the computer industry.

THE COMPUTER CHRONICLES, a weekly half-hour of public television that just might be the help you need.

The Computer Chronicles is funded in part by McGraw-Hill's BYTE *magazine. The Computer Chronicles is a co-production of WITF/Harrisburg and KCSM/San Mateo.*

THE COMPUTER CHRONICLES IS NOW ON BIX

Bix, the Byte Information Exchange, now has a conference for the Computer Chronicles.

Now you can communicate directly with the staff of the Computer Chronicles to suggest topics for future shows or to request information or details on past shows.

Once on Bix, just type "join comp.chron" at the colon (:) prompt.

Circle 205 on Reader Service Card

WIN LOTTO
BY MATHEMATICAL PROBABILITY,
NOT BY CHANCE

GAIL HOWARD is the nation's leading lottery expert. Her track record in helping Lotto players win big prizes is unprecedented in the history of lottery. At least **13 major Lotto prizes (including *TEN* first prize jackpots) totalling $30.8 million were won with Gail's systems!**

At last...now available on IBM PC 5-1/4" or 3-1/2" diskettes the complete authentic Gail Howard Wheeling Systems, the ***Smart Luck Computer Wheel*™** and the famous Gail Howard *Lottery Advantage* number selection methods, the ***Smart Luck Computer Advantage*™**. Both systems are menu driven (user friendly).

GAIL HOWARD'S SMART LUCK COMPUTER WHEEL™ ($29.95+$2 s/h) has a unique built-in Balanced Game™ feature which **makes all other wheeling systems *obsolete***. Gail Howard's Balanced Wheeling Systems™ are truly a mathematical breakthrough for the Lotto player.

Over 100 Wheeling Systems with minimum win guarantees. Includes economical Power Number™ Abbreviated Balanced Wheels™ to stretch your Lotto dollar. Good for all Pick-6 Lotto games in the world; includes systems for Pick-5 and Pick-7 Lotto games. System checks for wins.

GAIL HOWARD'S SMART LUCK COMPUTER ADVANTAGE™($39.95+$2 s/h) has the most successful number selection ever devised for beating the odds in Lotto. Includes Drawings Since Hit Chart™, Skip and Hit Chart™, Multiple Hit Pattern Chart™, Double Hit Ratios™, Companion Number Chart™, Neighboring Pairs™, Hit Charts for any time period, the *entire* historical winning numbers list for one Lotto game of your choice ($7 for each *additional* Lotto game) and a maintenance program so you can update the file. Available for any state or international Lotto game. **Please specify *which* Lotto game(s).**

GAIL HOWARD'S BOOK, *LOTTO: HOW TO WHEEL A FORTUNE* (228 pages -$14.95+$2 s/h) is the companion book to the Smart Luck Computer Wheel™. It contains important information not on the diskettes.

List of Gail Howard's latest lottery books and monthly publications available on request.

SMART LUCK
COMPUTER SYSTEMS

VISA MasterCard

Dept. B-4 • P.O. Box 1519 • White Plains, NY 10602 • **312-934-3300**

QSET:
The Simple Approach to Powerful Solutions.

Menu driven
No new language
AT type environment
Rapid prototyping
Multi-user
Data and system integrity

And simple means *fast!* Applications in *use* instead of in development. Applications *completed* when other system developers are still getting started.

QSET is the most productive approach you can take to I/O applications. Easy to learn, fast, and flexible. Combines the power of UNIX, Xenix, C, and any 3GL you choose for powerful, portable applications. Supports relational, hierarchical, and network database structures.

Built-in program logic insures data and system integrity: you can't build a bad application using QSET.

Find out more. Call 800-727-2072. Ask for our product brochure and our very attractive introductory pricing offer.

QSET An Applications Software Solution.

QSET is a trademark of Business Management Data, Inc.,
UNIX is a trademark of AT&T. Xenix is a trademark of Microsoft Corporation.
AT is a trademark of International Business Machines Corporation.

ms.dos/other #1317, from jfleming (Jon Fleming). A comment to message 1314.

>use a different parameter-passing scheme

Will this "break" existing programs that use Int 25h or 26h?

ms.dos/other #1318, from rduncan. A comment to message 1317.

No, because Int 25h and Int 26h work the "old" ways on the "old" types of partitions. However, a lot of Norton Utilities-type things won't work on the new huge partitions.

ms.dos/other #1319, from ronlepine (Ronald Lepine). A comment to message 1318.

>However, a lot of Norton Utilities-type things won't work
>on the new huge partitions.

We had that problem with large partitions in PC-MOS/386. I know I also tried smaller partitions, but I'm not sure that completely solved all problems. I know it solved some because I decided to leave it that way. Isn't it nice-some multiuser, multitasking DOS workalikes may be more compatible and have more features than PC-DOS 4.0.

Here's some real questions, though.

1. Will it work with older 8088 machines as well as the 80286 PS/2 series?
2. If it does work, will there be some restricted calls?
3. Will enough people upgrade to it (there are a lot of PCs out there) to make support for it required? Or will only people with huge databases switch? Will only those with database-type products support it?
4. Wouldn't those with large databases already have moved to faster processors/other operating systems, and wouldn't those trying to move down to PCs decide on OS/2 or another alternative?
5. With multitasking/multiuser alternatives that can run DOS programs and have more features, should you really consider going to another single-user/single-task operating system? If you have need for the large disks, I'd think it's likely you need more processor than an older PC has.

ms.dos/other #1320, from rduncan. A comment to message 1319.

From my understanding, it will run on any IBM PC, and there are no restricted calls.

ms.dos/other #1321, from billbourn (Bill Bourn). A comment to message 1309.

The IBM announcement letter is now in the listings area as file dos40.ark. Note that PKXARC is required to unsquash it. I call the files that require the PK-series ".ark" to avoid grief later. Let me know if you have trouble with the format.

TSR HANDLE PROBLEM

ms.dos/secrets.2 #15, from dmick (Dan Mick).

Apparently, if you redirect stdout for a TSR program, you permanently lose one handle from your FILES= number. This happens with DOS 3.3 and 3.2, at least. Try running a little program that opens as many files as it can simultaneously and see how many you get. Then do some MARK>NULs and see the number go down. Weird, eh?

Circle 29 on Reader Service Card

ms.dos/secrets.2 #16, from billbourn. A comment to message 15.

Just as speculation, if you redirect a TSR's stdout, does a handle have to be used to do that? And since the TSR hasn't ended, the handle isn't released yet, so the available number is decreased until the TSR ends. This has implications for those neatniks who redirect their batch AUTOEXECs. The unavailable handles might stay that way for the whole IPL?

ms.dos/secrets.2 #17, from twagner (Thomas Wagner). A comment to message 15.

Not so weird. If you redirect stdout and the program that "owns" this file terminates and stays resident, the file must remain open for the TSR to use it. Only if the TSR explicitly closes the file does the handle become available again. It's different with the normal standard handles, because they are all mapped to one internal handle. NUL, apparently, is not such a special handle.

ms.dos/secrets.2 #18, from rkrten (Robert Krten). A comment to message 16.

I usually redirect messy programs, like "print /d:prn >nul," but surely you cannot redirect the whole AUTOEXEC.BAT? (Actually, if you *can*, I could really get right into that.)

This raises the question: Does my redirecting the output of PRINT.COM to NUL chew up a file handle? Or does only part of the PRINT.COM program fork off and become resident?

ms.dos/secrets.2 #19, from dmick. A comment to message 18.

If you have C, try this program to find out. Do it before the "print>nul" and after:

```
/* eathand.c */
#include <stdio.h>

main()

{
  FILE *fd[30];
  char fn[10];
  int i;
  int c;

  for (i=0; i<30; i++) {
    strcpy(fn,"FILE");
    c = i + 'A';
    strcat(fn,(char *)&c);
    fd[i] = fopen(fn,"w");
    if (fd[i] == (FILE *)NULL) break;
    printf("%s: %d\n",fn,fileno(fd[i]));
  }
}
```

ms.dos/secrets.2 #20, from dmick. A comment to message 17.

Ah, I think I see what you mean. The "normal handles" are mapped to internal handles 0 to 2, actually, but for in/out/err it's all 0, and those never get closed at all. However, yes, NUL must be created as another entry (just thought of a way I can find out, actually) and then not closed because TSR is different from TERMINATE. Hmm. Anyway, it certainly has dire consequences for redirecting output from a TSR; you'll have fewer handles than you expect (and may not notice for a while). News, if not odd.

continued

Circle 207 on Reader Service Card

No more drudgery.

Let's face it. Math is 2% inspiration and 98% drudgery. If you're not inspired by math, it's only because you haven't used **Derive,™ A Mathematical Assistant!** You can be creative; **Derive** does the drudgery.

Derive intelligently applies powerful transformations to automatically simplify and solve complex mathematical problems. Its in-depth knowledge of math includes the fields of arithmetic, algebra, trigonometry, probability, statistics, matrices, and calculus.

Derive is more than a computer algebra system. It plots mathematical expressions in 2 and 3 dimensions. It evaluates functions numerically to any desired degree of precision. It gives you the freedom to explore—and make mistakes—without wasting hours of your time.

How about **Derive's** easy to use menu driven interface? We only have room to say that **Derive** lets you follow the thread of your inspiration.

Derive, A Mathematical Assistant.

2000 years of mathematical knowledge on a disk.

Derive was created by the authors of the **muMATH**™ symbolic math system and the **muLISP**™ LISP programming environment.

Derive lists for $200 and runs on PC compatible computers with 512K. Write or call for more information. Dealer inquiries welcome.

Soft Warehouse INC

Handcrafted software for the mind.

3615 HARDING AVENUE, SUITE 505
HONOLULU, HAWAII 96816 U.S.A.
(808) 734-5801 after noon PST

Derive is a trademark of Soft Warehouse, Inc.

Circle 190 on Reader Service Card

98.9% Radiation and 100% Static Free Working Environment

RCS 581 VDT Filter
- 98.9% radiation and 100% static free level.
- Eliminates glare and reflection.

RCS 582 Anti-Static Computer Cover
- Made of conductive fibers prevents charge collection and provides full static shield.
- Prolongs the computer's life two times.

RCS 583 Anti-Static Keyboard Strip
- Made of highly conductive fibers.
- Includes a 3-meter grounding cord.
- Doubles computer's lifespan.

RCS 587 Anti-Radiation Operator Apron
RCS 588 Anti-Static Car Seat Cover
RCS 590 Anti-Static Fabric
RCS 593 Anti-Static Steering Wheel Cover

Patents: U.S.A., R.O.C.
Patents pending: EEC, Japan, Korea.
See us at
COMDEX/Fall '88
November 14–18, 1988
Bally's Las Vegas
Las Vegas, Nevada
Booth: B519

Distributor Welcome

RCS **RCS TECHNOLOGY CORPORATION**
12F., No. 148, Sung Chiang Rd., Taipei, Taiwan, R.O.C. Tel: 886-2-5512614 (Rep)
Telex 28902 RCSTEC Fax: 886-2-5363696

- **Remains in Place** while you use your computer.
- **Avoids Costly Repairs.** Protects delicate electronics from dust, spills, smoke, ashes, staples.
- **Soft, Flexible,** retains normal keyboard feel.
- **Washable, Durable High-Tech Polymer** lasts years.
- **Hundreds of Models.** SafeSkin is available for most PCs, laptops, workstations and clone keyboards.
- **Office • Home • Factory • Classroom • Laboratory**

List Price $29.95. Please call or write for free color brochure. Dealer inquiries encouraged.

SafeSkin™
Keyboard Protector
Merritt Computer Products, Inc./4561 S. Westmoreland Dallas, Texas 75237/(214) 339-0753 • Fax (214) 339-1313

Circle 137 on Reader Service Card

IBM PS/2

MODEL 80 MEMORY EXPANSION

ibm.ps/model.80 #846, from rfm (Richard MacAllister).

I have a Model 80-041 with only 1 megabyte (minimal configuration). Now that memory-expansion boards seem to finally be available, does anyone know if I can put in extra memory on the MCA bus without putting in the other 1-megabyte "system board" (actually a little daughtercard) memory from IBM? Are there any gray marketers selling the IBM memory expansions at a discount?

ibm.ps/model.80 #849, from jgotwals (John Gotwals). A comment to message 846.

Since the memory "daughtercard" that plugs into the system board is faster than memory added via the MCA, why would you want to add MCA memory before adding the second memory card?

ibm.ps/model.80 #860, from rfm. A comment to message 849.

Because memory not by IBM is likely to be Much Cheaper, at least when the current RAM crunch goes away.

WHEN IS 4 MEGABYTES NOT 4 MEGABYTES?

ibm.ps/model.80 #851, from ereno (Edward Reno).

I finally got my 80-111, and I had it delivered with supposedly 4 megabytes installed. When I boot up, however, it clicks off to only 3986 (or something close to that–I don't have the machine here right now). I immediately called my supplier, and he gave me a story that sounded, well, unbelievable.

He says that IBM's been having trouble fabricating true 1-megabit chips and that this is reflected in their 2-megabyte expansion card, which doesn't quite make it to 4 megabytes (i.e., original 2 Mb + expansion-card 2 Mb). I have the authentic IBM expansion card.

Is he right, or am I being sold a bill of goods?

Also, I want to go to 8 megabytes. He's suggesting an Everex card that he *thinks* will work. Wants to send it to me with 1 megabyte on it to try it out. If it works, he'll send me the other 3 megabytes. Should I? Also, should I be specific as to the nanosecond rating of the chips on the Everex board? The IBM chips are supposedly 80 ns.

The point of all this memory is that I want to use 386MAX to turn it all into expanded memory so I can build gigunda spreadsheets in 1-2-3. I assume that 386MAX will let me do this?

ibm.ps/model.80 #852, from billbourn (Bill Bourn). A comment to message 851.

You might try your Everex question on the folks in the ecsd (Everex) conference.

ibm.ps/model.80 #853, from mpeppler (Michael Peppler). A comment to message 851.

I believe that the ROMs are copied to RAM at boot time, and that it is reflected in the RAM byte count. On our Model 80-111s with 2 megabytes, we get 1920K bytes instead of 2048. The difference (128K bytes) is equal to the ROM size.

In any case, checking the system with the installation disk shows that we have 2 megabytes physically installed but only 1.9 usable (and there is no way to change it).

ibm.ps/model.80 #854, from matt.trask (Matt Trask). A comment to message 853.

Some MCA adapters (I believe that the ESDI controller is one of the guilty) will grab memory off the top of 640K bytes at boot time, but I guess that doesn't explain where 128K bytes from the top of memory goes.

ibm.ps/model.80 #858, from suer (Sue Rosenberg). A comment to message 851.

Two points. About the memory: You should get all the advertised memory. Take the card back. But you still might not be able to access all 4 megabytes with your 1-2-3 spreadsheets. Version 2.01 stores pointers to that 4 megabytes of memory in the (in)famous 640K-byte region. If your spreadsheets have lots of equations, you'll have too many pointers to fit within the 640K barrier, so you'll end up with a couple of unused megabytes of memory up there and an incomplete spreadsheet.

ibm.ps/model.80 #859, from cpapoudaris (Christos Papoudaris). A comment to message 851.

80-111 Shadow BIOS: The highest 128K bytes of memory are used as Shadow BIOS (BIOS copied to RAM) for faster access.

AT KEYBOARDS FOR PS/2s

ibm.ps/model.80 #855, from rbrukardt (Randall Brukardt).

Is there any place that we can get real AT-style keyboards for our PS/2s? Our programmers hate the so-called "Enhanced" keyboards to the point where no one will use the PS/2 Model 80 for anything but testing. I suspect that this is partially because of the editor we're using (which will delete lines when you try to change windows if you reach a bit far and hit the function keys instead of the number keys), but in any case, I'd like to make the machine usable.

ibm.ps/model.80 #856, from jfachini (John Fachini). A comment to message 855.

Sounds like time to get a better editor, not keyboard.

ibm.ps/model.80 #861, from rbrukardt. A comment to message 856.

Better programmers, too!? I'm not thrilled at having two different keyboard layouts around here again. (I just got rid of all the oddball non-AT layouts). Different layouts make it very hard to move from machine to machine. We're trying a Northgate keyboard to see if that will do the trick.

2-MEGABYTE MEMORY LIMIT?

ibm.ps/the.bus #126, from awright (Alexander Wright).

A recent article in PC Week said that the Micro Channel spec was somehow flawed (or incomplete) so that designers couldn't figure out how to make a memory card larger than 2 megabytes. I can't see anything in the spec that would restrict a card to 2 megabytes. Anyone else out there see something I don't?

continued

Circle 3 on Reader Service Card

9-TRACK MAG. TAPE SUBSYSTEM*
FOR THE IBM PC/XT/AT AND...

For information interchange, backup and archival storage, AK Systems offers a 9-track, IBM format-compatible ½" magnetic tape subsystem for the IBM PC, featuring:

- **IBM format 1600/3200 and 800 cpi.**
- **Software for PC-DOS, MS-DOS, XENIX.**
- **Also for AT&T, DEC, VAX, VME, S-100, RS-232, IEEE 488.**

★formerly IBEX Mainstreamer

Write, phone or TWX for information.

AKSystems
20741 Marilla St.
Chatsworth, CA 91311
(818) 709-8100
FAX: (818) 407-5889
TWX: 910-493-2071

PRICE SLASHED!

FREE Software!

SONY *Quality*

THE 3.5" CONNECTION!

The perfect solution for upgrading your existing PC/XT/AT to "State Of The Art" 3.5" floppy disk technology! The Model 853W (720K) and Model 873W (1.44MB/720K) 3.5" drives are "drop-in" replacements for 5.25" drives! Disk format is fully compatible with popular Laptops (IBM, Toshiba, Zenith, etc.) and the new IBM PS/2 models. Both units come completely assembled and contain everything that you need, including Premium SONY drive, interface adapters, software device drivers and complete documentation. These drives utilize your existing controller so no additional slots are required (1.44MB requires AT class controller or special PC/XT High-Density Controller available from Tigertronics). Available with gray or black bezel (specify).

Model 853W
(720K)
~~$159.95~~
$129.95

Tigertronics INCORPORATED
400 Daily Lane • P.O. Box 5210
Grants Pass, Oregon 97527

Model 873W
(1.44MB)
~~$229.95~~
$159.95

IMMEDIATE DELIVERY!
Call 503 474-6700 or 503 474-6701
FAX 503 474-6703

VISA MasterCard

Circle 225 on Reader Service Card

ibm.ps/the.bus #128, from curtf (Curt Franklin). A comment to message 126.

I've heard rumors about this, too, but I've got an 8-megabyte board sitting in a Model 50 here, and it works fine. For those who are interested in more info on Micro Channel memory boards, a review of seven boards will be posted on BIX (probably in the ibm.ps conference) sometime in the next couple of weeks.

OTHER MCA MACHINES?

ibm.ps/the.bus #130, from awright.

I was looking through the Model 80 Technical Reference today and noticed an interesting comment. On the page following the default cycle timing, it shows a small diagram of the RTN signals. Note 2 about CHRDYRTN says something like, "this signal is a positive AND of all the CD CHRDY signals. Note that this is a change from other machines using the Micro Channel architecture."

Checked the Model 50/60 Technical Reference. Same diagram, but the note is different. However, the written description of CHRDYRTN says (in both manuals) that it is a positive AND, etc. Now what other machines used the Micro Channel architecture? Hmmm...

ibm.ps/the.bus #132, from rfm. A comment to message 130.

IBM execs are on record stating that there will be Micro Channel RTs. However, I wouldn't read too much into this. They very well might have designed the 50/60 bus, documented it, done the 80 bus, discovered that this is what the line ought to do, changed the 80 bus and put the note in since they didn't think they'd have time to change the 50/60 bus, found that they *did* have time to change the 50/60 bus, changed the 50/60 bus, but ran out of time and didn't get the note taken out of the Model 80 documentation. All this is pure speculation on my part, but it does sound like The Way Things Work, doesn't it?

ibm.ps/the.bus #133, from awright. A comment to message 132.

Yes, it does. Discovered the same note in the seminar proceedings. Could be the original (or different) Micro Channel used a "wire-ored" Ready line, like most buses do.

HELP WITH UNDOCUMENTED SYSTEM ERRORS

ibm.ps/the.bus #134, from jursery (Jesse Ursery).

Help! I am trying to figure out what is going wrong with an interface card that we designed to work on the Micro Channel. The card seems to behave properly on our Model 50 when the automatic configuration program is run. But when the system is rebooted, we get a long beep followed by two short beeps, then either system error 101 or system error 108. These are system board or power supply errors, in general, but we need to know specifically what the errors indicate because we are virtually certain that the problem is associated with our interface card. Can anyone tell me what these errors mean?

For reference, the card is a clone of one of our PC-bus cards, which looks like 64K bytes of memory and a single 8-bit I/O port (no DMA and no interrupts). The card is actually a shared-memory interface to a microprocessor-based instrument. We have analyzed the card's bus interface logic, and it appears to work just like the Technical Reference describes. We can enable the card with Debug, and the card functions correctly with our software, but we can't get past the power-on self test with our card in place.

ibm.ps/the.bus #135, from mslater (Michael Slater). A comment to message 134.

Does your card stay off the bus until CDEN is set (POS[1] bit 0, I think)?

ibm.ps/the.bus #136, from jursery. A comment to message 135.

Yes. From CHRESET until CDEN, we are completely isolated from the bus. Any other ideas?

ibm.ps/the.bus #137, from chips (Mark Garetz). A comment to message 134.

You *do* have an Adapter Description File for it, don't you? If not, can you tell if the system aborts before or after your card is initialized?

ibm.ps/the.bus #141, from jursery. A comment to message 137.

Yes, we have an ADF, and the system seems to initialize the card correctly. The problem is that when we reboot after configuring the card, we get nothing but the undocumented system errors. Any other ideas?

MCA ENHANCEMENTS?

ibm.ps/the.bus #138, from mramsden (Mike Ramsden).

A buddy of mine (unenlightened re: BIX) is bugging me to find out if there is any info floating around on BIX about possible extensions or enhancements to the Micro Channel (32-bit version). The president of one of the local hardware shops here in Toronto tells him that there are rumors floating around to the effect that the MCA will have new features added this year. I'm wondering if these are simply extensions for the RT PS/2 machine; my buddy is concerned about buying a Model 80 because he thinks it might be made obsolete quickly if there is indeed a "fixed" 32-bit MCA bus. Anyone hear any interesting rumors?

ibm.ps/the.bus #139, from chips. A comment to message 138.

IBM has essentially implied that it will increase the transfer rate to 20 megabytes per second as the first enhancement. Reading through the lines, this means 32-bit DMA. Note that the architectural spec for the Micro Channel doesn't preclude this now, just the system implementation. IBM also doesn't say when. It *will* mean a new machine and new controllers to take advantage of it. My guess is not soon—maybe a year.

Also note this interesting tidbit gleaned from IBM just yesterday: The matched memory cycle (IBM's way of "violating" its own spec) is intended to be defined from a timing standpoint on a machine-by-machine basis. Those who have assumed that the 187.5-ns timing in the Technical Reference is the upper limit for a matched memory cycle are wrong.

Another note: IBM says it is working on a solution to the 2-megabyte memory problem (other than requiring a ROM on each memory card) and will announce it within a month or so. It is currently evaluating several options and hasn't decided which one to go with yet. As I see it, the options are:

1. Replace everybody's BIOS ROMs.
2. Patch OS/2.

3. Do both (well, start shipping machines with fixed BIOSes and patch OS/2 to take care of machines already shipped).

ibm.ps/the.bus #140, from jrichter (Jake Richter). A comment to message 139.

From the PC Week article about the MCA evolving over the next few years, it seemed that an updated bus design might be in the works. This seems kind of tied in with the previous message. My concern is that yet another generation of hardware boards will have to be designed for the new bus-i.e., rendering the up-and-coming PS/2 MCA boards useless for the enhanced design. Any comments?

ibm.ps/the.bus #142, from mslater. A comment to message 140.

I'd be surprised if IBM enhanced the bus in such a way that old cards wouldn't work on the new bus. It's more likely that they'll add features and high-speed matched-memory cycles that will be transparent to older cards. Existing memory cards may well not work at full speed in new machines.

ibm.ps/the.bus #143, from cjackson (Craig Jackson). A comment to message 142.

IBM is unlikely to enhance its own cards into incompatibility. However, the cards were most likely designed to a slightly different spec than the spec publicly distributed. One that has more information about future directions.

OS/2

I/O

os.2/kernel #887, from abrunner (Andy Brunner).

I wrote an FAPI application that drives the IRMA 327x board directly through In/Out instructions in C. In PC-DOS and the DOS mode of OS/2, everything works fine. I now tried to set up IOPL for the C segment, which does nothing else than inp(xx) and outp(xx). Before calling this IOPL C segment, I also did the necessary DosPortAccess. But I get a TRAP 0D exception at entry to my IOPL segment. I am passing a parameter to the IOPL segment (the value to be sent to the I/O port).

1. Is it possible to use a C function as an IOPL segment?
2. If the answer to (1) is yes, is it possible to pass a parameter to it?
3. If (1) and (2) are yes, what did I do wrong?

os.2/kernel #888, from barryn (Barry Nance). A comment to message 887.

This is a dumb question, but I have to ask it: Do you have IOPL=Yes in your Config.Sys file?

os.2/kernel #889, from abrunner. A comment to message 888.

There is no dumb question...But yes, IOPL is enabled. Strangely enough, when I remove the parameter passing to the IOPL segment and add a dynamic link library call (such as DOS...API call), I receive an error message, telling me that dynalink calls are not allowed from ring 2. This is true-therefore I *am* at IOPL level 2. So I suspect that the problem is with the parameter passing on the stack, which might be on a wrong ring authorization level.

continued

Circle 254 on Reader Service Card

PROTECT INTELLIGENCE
WITH INTELLIGENCE

SOFTWARE PROTECTION KEYs BY PROTECH

PROTECH KEYs:
☐ are totally transparent to the end user
☐ allow unlimited back up copies
☐ free up disk drives
☐ do not interfere with peripheral operations
☐ are easy to install
☐ protect software developers' revenues
☐ assembler based routines (not drivers)
☐ encrypted routines
☐ physically unique hardware KEYs
☐ sophisticated software installation advice
☐ provide the highest level of protection available

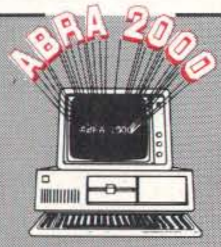
THE KEY
The KEY provides effective software protection while insuring customer satisfaction. The KEY is a random response device which is designed for identically reproduced software packages.

THE MEMORY KEY
The MEMORY KEY is a programmable software protection device. Each byte of memory can be addressed in groups or individually. Possible applications for the MEMORY KEY include:
☐ modular package control
☐ serialization
☐ customization
☐ access control to PCs
☐ demo control
☐ software leasing
☐ updating modules in the field
☐ any "counter" operation

For a demonstration package or additional information, please write or call: 1-800-843-0413

PROTECH MARKETING, INC.
1804 W. Southern Parkway • Bldg. A-112
Durham, North Carolina 27707
(919) 490-4970 FAX (919) 490-4974

WE HAVE THE *KEY* TO SOFTWARE COPY PROTECTION



ABRA 2000
only $995 for IBM PC & Macintosh
Human Resources

***Magically* cuts paperwork and saves time.**
Prepares accurate personnel reports instantly!

The ideal solution for most personnel needs:
- Complete Employee Record Keeping.
- Salary Reviews, Job History & Salary Analysis.
- Benefit Statement, Insurance & COBRA Reports.
- EEO Reports, I-9 Tracking, Injuries & Licenses.
- Organizational List, Phone Directory & Birthdays.
- Skill Retrieval, Education, Training & much more.
- Over 50 Reports, plus optional report writer.
- Attendance Tracking & Multi-User options.
- **New Applicant Tracking System available.**

Easy to use – even for novices. And ABRA 2000 is "proven" with over 800 happy customers.

It's not an illusion... Test the magic!
Call Today or Send $25 for Demo and Manual.

ABRA Cadabra
SOFTWARE

5510 - 9th Street North, St. Petersburg, FL 33703 (813) 525-4400

Circle 2 on Reader Service Card

os.2/kernel #890, from rduncan (Ray Duncan). A comment to message 889.

I don't know anything about writing IOPL routines in C yet, but the symptom you are having sounds like the problem I had when I failed to clear the parameters from the stack properly with a "RET n" to exit from the routine in the IOPL segment. Maybe you need to declare the IOPL routine as FAR PASCAL or something?

os.2/kernel #895, from cyco.netherlan (Cyco Automatisering). A comment to message 890.

On IOPL segments:

You can have IOPL segments, but there are some strange things about them. First, the DosPortAccess makes no sense (and you can indeed forget about calling this function) because when you have IOPL=Yes, an IOPL segment can access any port, anyhow, and if you don't, a program with an IOPL segment won't even start. The special problem is to pass parameters to a function. The IOPL function will have its own stack. So, forget about DS==SS as normal in C programs.

If you pass parameters via the stack, you should copy the part of the stack you want from the old stack to the new one. (Note that DS is your old SS. I can't remember how to get the old SP, but I'm pretty sure that it can be found.)

Most strange, I think, is that you can tell the processor (through some info in your descriptor) that it should automatically copy an area from the old stack onto the new one. But I can't find any reference in the manual on how to put this in the .DEF file (where I think this belongs). I did look in the link.exe file to see if some text could be found that reminded me of copy or stack copy or so, but no luck. So I think it really isn't there. Further, remember that you can *never* call a non-IOPL function from an IOPL function. This should automatically be clear to you if you understand what privileges are all about.

os.2/kernel #897, from rduncan. A comment to message 895.

True, DosPortAccess doesn't "do" anything in the current version, but you should follow the rules and make the appropriate calls to it in your program anyway. In the 80386 version, the kernel will be able to control port access on a per-process basis, and DosPortAccess will be necessary. Presumably, "old" 16-bit protected-mode applications that are running under the 32-bit version of the operating system and don't call DosPortAccess will fault and terminate.

The parameters are copied from the ring 3 stack to the ring 2 (IOPL) segment stack automatically. Each IOPL routine must be specified with an EXPORT segment in your .DEF file, and the argument for the EXPORT segment is the number of stack cells to be copied. The EXPORT statement puts something into the file header that causes a call gate to be built for the routine at run time.

In OS/2 1.1, they have changed things a little bit. Many of the DOSxxx routines are now "conforming," which means they can be called from the IOPL segment. There is also a new API called DosCallBack, which lets a ring 2 routine call any ring 3 routine in the same process.

FOREGROUND AND BACKGROUND

os.2/kernel #883, from ddoman (Daniel Doman).

It turns out that Microsoft has some funny ideas about "foreground" and "background." My application needed to know if it was running in the foreground or the background. The LocalSeg structure ForeGround flag is only set *after* keyboard I/O. Once you have read from the keyboard, you can reliably call DosGetInfoSeg and test the foreground flag in the LocalSeg structure. If you DosExec, however, the keyboard focus is lost, and the flag cannot be used *until* you read from the keyboard again.

I submitted a TAR to Microsoft, and they said, "Yeah, so?" So I think it's a bug.

os.2/kernel #893, from greenber (Ross Greenberg). A comment to message 883.

Take a look at the hack in my DLL article in MSJ.

Basically, if gdt->ground_process==ldt->parent_pid, then you're in OK shape.

os.2/kernel #900, from ddoman. A comment to message 893.

I did try comparing gdt->foreground_process to ldt->parent_pid and did not find the results consistent. According to Microsoft, the foreground process is the last process to have had the keyboard focus. That's not my understanding of the word ForeGround. I'm a mere mortal, but I have always thought of the foreground process as the guy in the foreground *now*.

os.2/kernel #901, from rduncan. A comment to message 900.

The foreground process is the last process to call KbdGetFocus or KbdCharIn.

os.2/kernel #902, from greenber. A comment to message 901.

Interesting. I found the results to be consistent across 1.0. I'll have to play some more with 1.1.

Hmmmm.

OS/2 ON TANDY 3000

os.2/kernel #894, from rkrten (Robert Krten).

Does OS/2 run on the Tandy 3000 series of computers? I would like to know for all the various HD, HL, etc., configurations.

os.2/kernel #903, from mnice (Mike Nice). A comment to message 894.

Beware of trying to run the Microsoft SDK version of OS/2 on the Tandy 3000HL. After trying a ROM upgrade, it still didn't even begin to boot-some sort of incompatibility in the bootstrap code. I finally ended up trading with someone else for an IBM PC AT. I heard that the 3000HD can run Microsoft's OS/2 with the proper ROM. In any case, both should be able to run Tandy's version of OS/2, possibly with ROM upgrades.

DISK GEOMETRY

os.2/kernel #896, from bkliewer (Bradley Kliewer).

I realize OS/2 doesn't use the BIOS for disk support, but what about the drive geometry? I have a Seagate ST4096, which has nine heads and 1023(?) cylinders. I'm considering getting a PROM that extends the drive table. My question is, will OS/2 read the PROM, or does it have its own internal table (and if so, could I modify one of the unused entries)?

A second (unrelated) question: OS/2 always hangs when I boot (IBM PC AT, but with an Inboard 386/AT). I suspect the Inboard is causing problems, but I should note that I didn't fill back the 640K bytes (I only have 512K for DOS). Does OS/2 need a full 640K bytes in the first megabyte of address space?

os.2/kernel #898, from glass (Brett Glass). A comment to message 896.

I recommend patching your ROMs or getting an extension PROM.

The problem with the Inboard, as best I can tell, is not related to memory size. Intel supposedly has a fix for it; call PCEO in Oregon.

os.2/kernel #899, from bkliewer. A comment to message 898.

This is a new (OS/2-compatible) Inboard. Intel says it should work. I was just wondering whether anyone else has had problems with it.

PHYSICAL MEMORY MANAGEMENT

os.2/kernel #904, from intel (Cliff Purkiser).

Is there a mechanism to free an area of physical memory away from use by OS/2? The purpose would be to use a specific area of physical memory for a device driver. When the device driver is not in use, it would be advantageous to let the OS/2 kernel use it.

Example:

An add-in card for a special graphics printer has 4 megabytes of memory on it. The memory is dual-ported, such that it can be accessible from the AT's CPU or from the printer's dedicated CPU. When the printer is not in use, the memory is used as any other normal extended memory.

When the printer is used, the printer's device driver signals the OS/2 kernel to free that 4 megabytes of memory. The kernel frees that area of memory and continues, ignoring the existence of that area of memory. Later, when the printer is finished, it can signal the OS/2 kernel that the 4 megabytes of memory is again usable.

Any ideas of what OS/2 calls would allow such operations?

os.2/kernel #905, from glass. A comment to message 904.

Yes, there is one, but it's a DevHlp, not an API call, which means it can only be called by a device driver. It's called AllocPhys.

os.2/kernel #906, from rduncan. A comment to message 905.

Not really. AllocPhys doesn't let you choose the address of the memory that the driver will use. It just allocates some "fixed" (nonswappable, nonmovable) memory and returns the linear address of that memory.

os.2/kernel #909, from rnelson (Ross Nelson). A comment to message 906.

Yeah, I haven't looked at the code recently, but what we do is request actual GDT slots and modify them ourselves to get the exact descriptor that we want. Protected mode? What protected mode?

continued

Circle 48 on Reader Service Card

Compact Disk Products, Inc.

CD-ROM/WORM

ALL PRODUCTS, LOWEST PRICES, EXPERT ADVICE

INTRODUCTORY OFFERS

Hitachi 1503S or 3500S CD-ROM Drive with your choice of:
- McGraw Hill Science and Technical Reference Set $895
- Grolier Electronic Encyclopedia $995
- Microsoft Bookshelf. $895
- PC-SIG Library (Disks 1 - 1000) $895

CD-ROM SOFTWARE

Oxford English Dictionary . . . . . NEW . $945
Comstock Stock Photography On CD . . . NEW . . . $445
Educorp Public Domain/Shareware for the Mac . . . . . NEW $249
The New Grolier Electronic Encyclopedia $359
McGraw Hill or Bookshelf or PCSIG $269
The Bible Library $495
Kirk-Othmer Encyclopedia of Chemical Technology $845
Registry of Mass Spectral Data $2655
Geovision U.S. Atlas and Mapmaker $795

TOLL FREE ORDER LINE · 800—MEGABYTe (634-2298)

CD-ROM and WORM DRIVES

Hitachi 1503S External CD-ROM Drive with Audio $729
1503S with Digital Audio Output $1229
Hitachi 3500S Internal 1/2 Height CD-ROM Drive w/Audio . . $719
Maxtor 800 MB WORM Drive $3799
Optotech Laserbank 400 MB WORM Drive $2799
Portable 286 with CD-ROM Drive $3795

CD-Play ($89) Pop-up utility that permits user to play all audio CDs on Hitachi and compatible drives. Output to headphones or amplifier.

CD-Play+Sampler ($149) Same features as CD-Play plus the ability to name two points on an audio CD and loop between them.

CD-AudioFile ($149) Automatically creates database records of all your audio CDs. Allows you to store a preferred play sequence for each disk. Automatic recognition of CDs. Creates DBase compatible records.

CDP
Compact Disk Products
217 E. 85th St.
New York, NY 10028
Tel. 212-737-8400
Fax 212-439-9109
Compuserve 75530,214

Free 3 Month Subscription to CD-ROM Review with orders over $300

INTERNATIONAL ORDERS A SPECIALTY

Australian Agent: KEWTEL
145 Cotham Rd.
Kew, Victoria 3101
Tel. (03) 817-5933

FREE Line Conditioner in every UPS.

SENDON
Affordable Power Protection

DEALERS
& DISTRIBUTORS
WELCOME
TEL: 416-470-6611
FAX: 416-479-7392

Now, at no extra charge, the new Sendon UPS back-up power supplies feature a built-in line conditioner that enables your computer to work indefinitely under brown-out conditions without drawing on the battery power reserve, which is saved for emergency uses (black-outs).

FOR MORE INFORMATION, PLEASE CONTACT:

N.J.	N.Y.	B.C.	Quebec
Instruments & Equipment	C.P.G.	Sonnet Systems	Jasmine Technology
TEL: 201-729-4293	800-431-9008	604-276-2599	514-871-2233
FAX: 201-729-5569	716-343-9912	604-276-0672	514-871-0616

COMDEX/Fall See us at the Fall Comdex Show in the Las Vegas Bally

Circle 199 on Reader Service Card

READING CONTROL-C

os.2/kernel #907, from leifur (Leifur Hekanarson).

In msg. 499, someone asked for info on reading Ctrl-C. He was referred to the SDK. Well, I have the Programmer's Development Toolkit, which does *not* document how to do this. Could someone explain how (perhaps by means of a program fragment)?

It seems to me that by marketing *two* development environments, Microsoft has caused no end of confusion, what with different spelling of library calls, etc.

os.2/kernel #908, from rduncan. A comment to message 907.

If you put the keyboard into binary mode with KbdSetStatus, you can read Ctrl-C and the other funny keys (like Ctrl-S) with the usual KbdCharIn and KbdStringIn.

If you do not really want to read Ctrl-C and Ctrl-Break, but instead want to prevent your program from being terminated by these keys, you need to register a signal handler for them with DosSetSigHandler.

WHAT SCREENS FOR OS/2 PM?

os.2/windows #149, from cyco.netherlan.

Does anyone know what kind of screens might be supported for the Presentation Manager? Will there be non-memory-mapped screens, and if there are, how should their states be saved? We think these screens are extremely important and *must* be supported in some way. BTW, for those of you who have the PM already, what's it like? We're burning to know, but Microsoft is very slow shipping its products to Europe (even slower than the PM release in the States).

os.2/windows #150, from gshapiro (Geoffrey Shapiro). A comment to message 149.

I am a bit confused by what you mean by "what kind of screens will be supported by the Presentation Manager." PM supports its particular brand of API (à la Windows and IBM's GDDM/SAA) to bit-mapped displays, printers, etc. In addition, PM supports a large subset of the OS/2 VIO API for character-oriented output.

Is either of the above two what you had in mind? If not, please clarify your original queries.

os.2/windows #151, from mlavelle (Mark Lavelle). A comment to message 150.

And in the question related to video modes, don't expect to see support for anything other than IBM MDA, CGA, EGA, and VGA for quite a while.

os.2/windows #152, from cyco.netherlan. A comment to message 151.

>what kind of screens

You (Geoff) selected a special kind of screen yourself: bit-mapped displays. There are, however, screens that are not memory-mapped. Is it possible (and if it is, will it be done) to use these screens as well with the PM? The problems I expect are with the saving/restoring with session switches. Microsoft keeps saying that the PM is just one session under the session manager. I can't believe it, but they say so and they should know. How (if there is no memory map of the screen) could the screen be saved/restored without a memory map of its contents?

Think of this: You are using AutoCAD with a very special screen (hardware zoom and pan, 200-inch screen with a 10000000×1000000 resolution). Can you expect to see a PM version of AutoCAD someday where this big-bucks screen is used, or is this impossible? If you can't, then what is the value of the PM? Does anyone have any idea how difficult it will be for a screen manufacturer to produce the drivers needed for his or her screen to be used on every OS/2 version?

os.2/windows #153, from cjackson (Craig Jackson). A comment to message 152.

I suppose that the manufacturer of such a screen would need to provide at least a replacement for the VIO subsystem. You'd have to be an OS/2 OEM to do that, I suspect.

os.2/windows #154, from rduncan. A comment to message 152.

The PM is certainly just one session under the session manager. You can have other sessions going, too, that contain "old-style" character-based APPS, or APPS that contain their own graphics drivers.

From what I can see about the way the video subsystem is organized, it should be a fairly straightforward job for the manufacturer of a display adapter to supply a new kernel driver (.SYS) and subsystem driver (.DLL?) to use with that adapter-particularly if the system will also contain one of the "standard" adapters. Then the new subsystem can just register itself with VIOCALLS.DLL (the video router) on a per-screen-group basis, and the screen groups it doesn't register for will still be directed to the standard adapter.

I don't see any reason why such a custom video subsystem would need to be maintained in any more than one version. The different OEM versions mainly involve hardware customizations of the base set of device drivers, different available code page sets, and possibly mods of the mode-switching logic to take advantage of any special hardware support. The interface between the kernel and the video subsystem and driver should not be affected by these things.

os.2/windows #156, from glass. A comment to message 154.

The question in my mind is: Why can't *any* developer write a screen driver with ordinary tools and have the user install it when the special adapter is installed? Why require it to be built into the kernel?

os.2/windows #157, from rduncan. A comment to message 156.

Nothing in the video driver or subsystem is built into the kernel, and it is all (theoretically) perfectly replaceable in the field. The problem is that the video subsystem really has three elements: SCREEN.SYS or the equivalent; BVSCALLS.DLL or the equivalent, which contains an IOPL segment to twiddle the hardware; and VIOCALLS, which routes VIOxxx API calls to BVSCALLS or another subsystem on a per-screen-group basis.

There is also another dynlink library, ANSICALL.DLL, which is called by BVSCALLS to interpret escape sequences embedded in VIOWRTTTY strings: It calls back to BVSCALLS via VIOCALLS using things like VIOSETCURPOS. All these elements work together in weird and mysterious ways, and the person who wants to completely replace the video subsystem has to duplicate all entry points and calling conventions (mostly undocumented, or vaguely alluded to, in the regular Programmer's Reference) in each of the modules. ■

THE BUYER'S MART

A Directory of Products and Services

THE BUYER'S MART is a monthly advertising section which enables readers to easily locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes a Reader Service number to assist interested readers in requesting information from participating advertisers.

RATES: 1x—$475 3x—$450 6x—$425 12x—$375
Prepayment must accompany each insertion. VISA/MC Accepted.

AD FORMAT: Each ad will be designed and typeset by BYTE. Advertisers must furnish typewritten copy. Ads can include headline (23 characters maximum), descriptive text (250 characters is recommended, but up to 350 characters can be accomodated), plus company name, address and telephone number. Do not send logos or camera-ready artwork.

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 9. Send your copy and payment to THE BUYER'S MART, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call Mark Stone at BYTE 603-924-3754.

ACCESSORIES

Companion and Extender

The PS/2 COMPANION lets you add an extra keyboard and monitor up to 150 feet away from your system unit. It comes complete with all connections and supports both color and monochrome monitors. Prices start at $249 for a 25′ unit.

EXTENDER lets you move the keyboard and monitor up to 150 feet from the system unit. Prices start at $149.

Cybex Corporation
2800-H Bob Wallace Ave., Huntsville, AL 35805
205-534-0011

Inquiry 576.

YOUR OWN COMPUTER PAPER

Put your name and/or department, project, proposal, or report across the bottom of every final presentation page. Send us your copy plus name, address, phone number and printer make and model number and we'll send you FREE SAMPLES.

FORMSMART, INC.
P.O. Box 592, E. Freetown, MA 02717

Inquiry 577.

SMART PRINTER STAND

UNDERSTAND
is an attractive printer stand with switchable data conversion, surge suppression & power switch. Saves space & avoids clutter!

UNDERSTAND-PP:
$295 (2 parallel in, 1 parallel out)

UNDERSTAND-PS:
$395 (1 parallel & 1 serial in, 1 parallel out)

MAS Inc.
15941 S. Harlem Ave., Suite 333, Tinley Park, IL 60477
(815) 469-4501

Inquiry 578.

DUST COVERS/TRAVEL CASES

We manufacture a complete line of quality, custom fit, nylon dust covers for all IBM and Apple/Macintosh equipment. We also offer custom fit travel cases for most Lap Top computers, and the entire Apple/Macintosh line. Both products are handmade in the U.S. by skilled craftsman, and are 100% guaranteed.

SOPRIS SOFTWORKS
P.O. Box 916, Glenwood Springs, CO 81601
1 - 800-334-6046

Inquiry 579.

ARTIFICIAL INTELLIGENCE

ATHENA

High Performance Rules Based Expert System Shell

Artificially high expectations have become reality! Thousands of rules with no degrading of performance. High performance rules based expert system in any area. Extendable to an almost indefinite degree of complexity. Neural design offers almost unlimited interconnectivity. Advance AI programming techniques maximise capability. Integrate with your existing data base. Easy to use, no knowledge of programming required. Applications: Medical diagnosis, fault diagnostics, business, admin, banking, finance, insurance, law, engineering, education, military command and control and many other application areas. Available on PC/XT/AT, MS-DOS, Xenix, Unix. Demo copy $84 (with facility to create 300 rules). Full version $21,000

Horizon Software Ltd.
27 East Street, Leicester, LE1 6NB U.K.
Tel (44) 533 556550 FAX (44) 533 470942

Inquiry 580.

ARTIFICIAL INTELLIGENCE

NEW Expert System

FirstExpert - expert system generator. Ridiculously easy yet extremely powerful. No programming needed. Speed up business decisions and analysis. Information transferable to other environments. Amplifies Your intelligence! An ingenious program for a sensational price. Many examples included.

$99 Call or write for more information.

NovaCast Expert Systems
2530 Berryessa Rd. Suite 607, San Jose, CA 95132
(408) 272-4071 fax: (408) 437-7777

Inquiry 581.

BACKUP SYSTEMS

HD BAC-UP

THE EASIEST & FASTEST BACKUP UTILITY
FOR PC/XT/ATS & COMPATIBLES.
AFFORDABLE PRICE $36.50.
EASY INSTALLATION & USE — REQUIRES
NO KNOWLEDGE OF DOS — DAILY BACKUPS RUN
IN A FRACTION OF THE TIME.
CALL FOR INFO & DEMO DISK 800-457-1313.

HI-TEC INDUSTRIES
6100 S. Fairfax Rd., Bloomington, IN 47401
812-824-8000

Inquiry 582.

BAR CODE

BAR CODES & BIG TEXT

On EPSON, IBM, OKI dot matrix or LaserJet. Design any format/size on ONE easy screen. 1-120 fields/label. 13 text sizes to 1″ — readable at 50 ft. AIAG, MIL-STD, 2 of 5, 128, UPC/EAN, Code 39, etc. Color, Reverses, File Input, FAST—$279. Other menu-driven bar code programs from $49. 30 day $ back.

Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938
See our display ad on page 22.

BAR CODE READERS

From the manufacturer for PC/XT/AT, & PS/2. Attaches as 2nd keyboard, reads as keyed data. External or bus install. With steel wand—$399. Also Kimtron, Link, Wyse, & RS-232. Portables, Lasers, slot badge readers, and MagStripe too!
30 day $ back.

Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938
See our display ad on page 22.

PRINT BAR CODES/BIG TEXT FROM YOUR PROGRAM

Add bar codes and big graphics text to your program. Print from ANY MS-DOS language. Bar codes: UPC, EAN, 2 of 5, MSI, Code 39. Epson, Oki, IBM dot matrix text up to ½″. **LaserJet up to 2″. Font cartridges not required. $159–$239. 30 day $$ back.**

Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938
See our display ad on page 22.

BAR CODE

COMPLETE LINE OF BAR CODE PRODUCTS

- PrintBar II
- PrintBar Softfonts
- PrintBar I
- CodeScan 2000

FREE BROCHURES *(916) 622-4640*

Bear Rock Software Co.
6069 Enterprise Dr. Placerville, CA 95667

BAR CODE SOLUTIONS

We make bar coding very easy with our complete line of readers. Our PC-Wand readers network, or work with your keyboard or terminal, or are carried around taking inventory, entering sales and clocking time. Our bar code label printing software packages work with MS-DOS or PC-DOS and most matrix or laser printers. We also sell pre-printed labels. Our hardware can work with nearly every computer in the world.

International Technologies & Systems Corp.
635-C North Berry St., Brea, CA 92621
(714) 990-1880 FAX: 714 990-2503 TLX 6502824734 MCI

Inquiry 583.

PC BAR CODE SPECIALISTS

Bar code readers designed for fast, reliable, cost effective data entry. Looks just like keyboard data! Choose from stainless steel wand or laser interface. Also, powerful Bar Code and Text printing software. Great warranty. Dealer inquiries welcome.

Seagull Scientific Systems
15127 N.E. 24th, Suite 333
Redmond, WA 98052

DATA INPUT DEVICES

Bar Code & Magnetic Stripe Readers for microcomputers & terminals, including IBM PS/2 & others, DEC, AT&T, CT, Wyse, Wang. All readers connect on the keyboard cable & are transparent to all software. Low cost bar code print programs & magnetic encoders are also available. GSA contract #GS00K87AGS5346.

TPS Electronics
4047 Transport, Palo Alto, CA 94303
415-856-6833 Telex 371-9097 TPS PLA

Inquiry 584.

BBS/PUBLIC DOMAIN

7,500 + Titles in Download Library

18+ Special Interest Forum message bases plus Real Time Conferencing. USA TODAY Decision-Line News Service. Quarterly Newsletter & BBS System Users Guide. PC Pursuit Accessible. Fee: $10/3 Mo. — $25/Yr.

9 Incoming lines. FREE DEMO MODE
(503) 761-8100 12/2400 N,8,1
RANDOM ACCESS Information Network
P.O. Box 16675, Portland OR 97216
Voice: (503) 239-8299

Inquiry 585.

THE BUYER'S MART

CASE

Affordable CASE

A new concept in **C**omputer **A**ided **E**ngineering for developing PC/DOS applications! C Dispatcher generates fast, efficient C code for command and menu driven applications. Develop, document, and change easily. Many features. For many compilers. $295.00 *MC/Visa*

Amaryllis Inc.
563 Wattaquadoc Rd., Bolton, MA 01740
(617) 365-5456

Inquiry 586.

PROTOTYPING TOOL

Build a **working** *system model* of your application with **PC-PROTO.** *Very Fast. Very Flexible.* No Programming Required. Screen Painter. Data Base Manager. Generate data dictionary, source code, documentation, programming specifications. *Suitable for JAD as well.* For PC, XT or AT. From $149.00. MC/VISA.

Kartech, Inc. **(416) 656-2032**
165 Pinewood Ave., Toronto, Ontario, Canada M6C 2V6

Inquiry 587.

CD/ROM

CD-ROM Drives & Titles

Largest selection for PC & Mac.

Drives from $699. *Hundreds* of titles from $29.
Money-back Guarantee.
MC/VISA/AMEX accepted.
Call or write for free 88 page catalog.
Get it all from "The Bureau"

Bureau of Electronic Publishing
121 Norwood Ave., Upper Montclair, NJ 07043
(201) 746-3031

Inquiry 588.

Public Data on CD-ROMs

- Econ/Stats I — Prices, Employment
- Consu/Stats — BLS/Census 1984 consumer data
- Agri/Stats — Agricultural series
- Makes tables, DIF, or ASCII
- $49 each, req. MS-DOS
- CD-ROM publishing services available

Hopkins Technology
421 Hazel Lane, Hopkins, MN 55343
(612) 931-9376 Compuserve 74017,614

Inquiry 589.

COMMUNICATIONS

MULTI-LINE PC-DOS BBS

The Bread Board System (TBBS). Secure, reliable, full-featured commercial information system for IBM XT/AT/386/PS2 or compatible. Menu editor allows customization by nonprogrammers. Kermit, X & Y-Modem. High performance allows up to 32 simultaneous callers. User audit trail.
300/1200/2400/9600 bps.

eSoft, Inc.
15200 E. Girard Ave. #2550, Aurora, CO 80014
(303) 699-6565

Inquiry 590.

IDEAPHONE®—TELEPHONE FOR YOUR PC NOW ONLY $149 WITH THIS AD

Full-slot PC board, puts phone on keyboard. FREE MS-DOS software. Keeps track of all calls, autodials from *any* application, automatically rings incoming calls, works with *any* standard telephone. Ideal for professional and home office use. Plantronics Spirit II Headset option, $70.

IDEATECH, Inc.
1806 T Street, N.W., Washington, D.C. 20009
(202) 667-4559

Inquiry 591.

COMMUNICATIONS

Bi-Directional File X-fers

Multi-Com telecommunications program offers the following.....
☆ *Simultaneous* Downloading/Uploading
- Send/Receive Console Messages During File Transfers
- 100% Line Utilization During Multi-File Transfers
- Uses Full Duplex ADLC Protocol
- More Efficient Than Xmodem, Kermit, etc.
- Saves Time and Cuts Connect Costs

Information & 5¼" Demo Disk	$5.00 + $3 s/h
Program Pkg., 3½" & 5¼" disks, manual	$49.95 + $4 s/h

Multiplex Systems (412) 276-3374 24 hrs.
P.O. Box 16174, Pittsburgh, PA 15242

Inquiry 592.

COMPUTER INSURANCE

INSURES YOUR COMPUTER

SAFEWARE provides full replacement of hardware, media and purchased software. As little as $39 a year provides comprehensive coverage. Blanket coverage; no list of equipment needed. One call does it all. Call 8 am–10 pm ET. (Sat. 9 to 5)

TOLL FREE 1-800-848-3469
(Local 614-262-0559)
SAFEWARE, The Insurance Agency Inc.

Inquiry 593.

COMPUTER RENTALS

RENTALS

WEEKLY MONTHLY YEARLY

IBM – APPLE
COMPAQ
Full Stock/Next Day Delivery
Free Service & Maintenance

$189 PER MO.
IBM PS/2 Model 50

800 PC-RENTL

Inquiry 594.

COMPUTER SYSTEMS

IBM

Model 30 8mhz 640k 2/3.5"	$1275
Model 30 8mhz 640k 20 mb	$1695
Model 50 10 mhz lm 3.5 20 mb	$2595
All Other Models Available	$ call

COMPAQ

Deskpro 256k 2 drive	$1295
Deskpro/286 640k 1.2 20 mb	$2495
All Other Models Available	$ call
8 mhz XT 640k 2dr mono	$ 695
10mhz AT 512k 1.2 20 mb	$1195
Peripherals & Software	$ call
HP LaserJet II	$1625

PC TECHNOLOGIES
(312) 430-2800

Inquiry 595.

CROSS ASSEMBLERS

CROSS ASSEMBLERS

Universal Linker, Librarian
Targets for 36 Microprocessors
Hosts: PC/MS DOS, micro VAX, VAX 8000
Developed and supported at:

ENERTEC, INC.
BOX 1312, Lansdale, PA 19446
215-362-0966 MC/VISA

Inquiry 596.

CROSS ASSEMBLERS

Macros, PC Compatible, Relocatable, Conditionals, Fast, Reliable .... from **$150**
also: Disassemblers
EPROM Programmer Board

MICROCOMPUTER TOOLS CO.
Phone (800) 443-0779
In CA (415) 825-4200
912 Hastings Dr., Concord, CA 94518

Inquiry 597.

DATA CONVERSIONS

DATA TRANSLATION

Tape/Disk • Disk/Disk • OCR

Transfer data to and from hundreds of formats, data types, and word processors. Quick turnaround!
- **IRS MAGNETIC REPORTING**
- Reformat databases to your specifications
- Translate and print mailing lists
- Quality word processor to word processor conversions
- SGML Conversion

DataCopy Service of Texas
3306 W. Walnut, Suite 400, Garland, TX 75042 **(214) 272-7751**

Inquiry 598.

PEP Your Data to MS-DOS!

PEP ("Printer Emulation Package") is a unique software product which makes your MS-DOS system appear to be an intelligent serial printer. Converting your data from another operating system is as easy as printing it! Diskette plus 90 page typeset manual, $64.95 U.S. (Not copy protected.) Specify 5¼ or 3½ inch diskette size; add $5 for both formats.

Intelpro
13 Saratoga Dr., Kirkland, Quebec, Canada H9H 3J9
(514) 694-6862

Inquiry 599.

DATABASE MGMT. SYSTEMS

FREE TRIAL dBASE III CLO!!

"1 on 1 is a programmable relational DBMS... 1 on 1 = 3!! is a great deal for those who would be glad to have a dBASE III PLUS clone"

**** PC MAGAZINE 5/17/88 ****

Free 30 day trial full program USA only or Buy now get free upgrade. Money back guarantee $69 + $5. *S/H chk/Amex. CAN +$4. Other +$10.* Call or write:

1 on 1 Computer Solutions
26 Finchwood Dr., Trumbull, CT 06611 **203-375-0914**
dBASE III is a trademark of Ashton-TATE

Inquiry 600.

SOFTWARE KIT PACKAGING

OEM supplier to one of the world's largest computer companies offers quality packaging and supplies for your software products. From diskettes to printed manuals. Quality products reflecting your company's image is our highest priority. Call or write.

COMPUTER LOGICS LIMITED
4845 Transit Road Unit K-8, Depew, NY 14043
(716) 633-2810 Fax (716) 633-2813

Inquiry 601.

ID_ENTITY RELATIONAL DBMS

Full **relational** power without programming. Retrieve data in multiple tables *easily.* Modify table structures to speed queries. Import & Export data fast. Report writer. ID_ENTITY makes relational tasks other DBMS's avoid **EASY.** $295 Reg. For limited time $99 plus UPS.

Horizons Unlimited & Assocs.
1786 Michael Lane, Pacific Palisades, CA 90272
(213) 454-4178

Inquiry 602.

COMPUTER CONVERSIONS

Get the Expertise You Need!

Disk/Disk • Tape/Disk • OCR

Over 1,000 formats! 3½, 5¼, or 8 inch disks; 9 track mag tape; 10 MB Bernoulli cartridge. Data base and word processor translation. Specialists in Government Security Data. Call for free consultation.

Computer Conversions, Inc.
9580 Black Mtn. Rd., Ste J, San Diego, CA 92126
(619) 693-1697

Inquiry 603.

THE BUYER'S MART

DATA/DISK CONVERSION

DISK CONVERSIONS

Media transfer to or from: IBM, Xerox, DEC, Wang, Lanier, CPT, Micom, NBI, CT, also WP, WS, MS/WRD, DW3, MM, Samna, DEC DX, MAS 11, Xerox-Writer, ASCII.

FREE TEST CONVERSION

CONVERSION SPECIALISTS
531 Main St., Ste. 835, El Segundo, CA 90245
(213) 545-6551 **(213) 322-6319**

Inquiry 604.

DISK & TAPE CONVERSIONS AUTOMATICALLY

SAVE TIME AND MONEY

Over 1000 formats from Mini, Micro Mainframe, Word Processors, & Typesetters.

TAPE Conversions as low as $23.00 MB
DISK Conversions as low as $15.00 per Disk
Call or write TODAY for a cost saving quotation.

CREATIVE DATA SERVICES
1210 W. Latimer Ave., Campbell, CA 95008
(408) 866-6080

Inquiry 605.

IBM PC ⇦ to ⇨ HP FILE COPY

IBM PC to HP File Copy allows IBM PCs, PS/2, compatibles to read, write files written by Hewlett Packard Series 70, 80, 200, 300, 1000, 9000's. We offer custom work using our file copy utilities and program translators. Call for estimate, catalog, data sheet.

Oswego Software 312/554-3567
507 North Adams St. **Fax 312/554-3573**
Oswego, Illinois 60543 **Telex 858-757**

Inquiry 606.

CONVERSION SERVICES

Convert any 9 track magnetic tape to or from over 1000 formats including 3½", 5¼", 8" disk formats & word processors. Disk to disk conversions also available. Call for more info. Introducing OCR Scanning Services.

Pivar Computing Services, Inc.
165 Arlington Hgts. Rd., Dept. #B
Buffalo Grove, IL 60089 **(312) 459-6010**

Inquiry 607.

DESKTOP PUBLISHING

Desktop Publishers!

When you need the best "no-nonsense" tools for **Screen Capture** and **Image Management**

Collage Display Utilities

Dynamic Grayscaling, Image Browsing and Cataloging, and *much, much more!* Supports **EGA, VGA, PS/2, CGA, Hercules,** and **MDA** displays!

Suggested Retail price, only **$\$89^{95}$**

Inner Media, Inc. (603) 465-3216, -7195 Fax

Inquiry 608.

DISK DRIVES

HARD DISKS

MN6128	110 MB	28MS	$699.
MN9380E	338 MB	16MS	$2399.
MN6085	71 MB	28MS	$545.
MC1355	150 MB	23MS	$1299.
MC1335	71 MB	28MS	$545.
ST4096	80 MB	28MS	$525.
ST251	40 MB	40MS	$329.
ST251-1	40 MB	28MS	$379.

CPU INC **(714) 870-9033**

Inquiry 609.

DISK DRIVES

PS/2 DRIVES FOR PC's AT's

CompatiKit/PC **$329**
CompatiKit/AT **$269**

Built-in floppy controllers—no problem. Supports multiple drives and formats. Lets your computer use IBM PS/2 1.4M diskettes *plus more!* Call for further information or to place an order. *VISA/MC/COD/CHECK.*

Micro Solutions Computer Products
132 W. Lincoln Hwy., DeKalb, IL 60115 **815/756-3411**

Inquiry 610.

ENTERTAINMENT

WIN THE LOTTERY with Artificial Intelligence!

A powerful *expert system*, including a neural network function, transforms the winning patterns from the past drawings of any pick/6 Lotto game, into mathematical formulas. These formulas *predict* the *lucky* numbers for you. IBM PC/compatibles, 256k. Check, MO for **$27.**pp, **$32.** Canada. Ontario add **8%.**

C.D. Recursive Knowledge Inc.
Dept. B1, P.O. Box 6817, Stn. J
Ottawa, Ontario, Canada K2A 3Z4

Inquiry 611.

★★CHESS SPECTACULAR!★★

At last a chess program designed for the new graphics standard. High resolution animation brings your EGA to life! Solves mate in 7. Huge opening book. Save/restart your games. Animated teaching mode. Select level. Take back/Change sides. On screen clock. **MUCH MORE! EGA Chess** $69.95 256k EGA/VGA 5.25" disk. *VISA/MC*

CUBE Microsystems
P.O. Box 26064, Overland Park, KS 66225
(913) 649-6747

Inquiry 612.

HOOKED ON BLACKJACK?

Blackjack Players— improve your play with an inexpensive but good (IBG) Blackjack program. Plays ALL Casino games and options. Blackjack V1.00 includes: • on-line basic strategies • simple card counts. For you card-counters there is a Pro-Player Upgrade feature that allows YOUR card counts and YOUR strategies. Machine requirments: • IBM/PC compatible (256K) • PC-DOS V2.0 or later. • BLACKJACK program $20.00 Pro-Player Upgrade add $12.50 (Specify diskette size) Money back guarantee 30 days — allow 4 weeks for delivery. Mail check or money order to: (FL res. add 6%)

IBG SOFTWARE
P. O. Box 27-6354, Dept. B, Boca Raton, FL 33427-6354

Inquiry 613.

NEMESIS™ Go Master™

Go is a popular Oriental game of intellectual complexity and elegance. NEMESIS, recognized worldwide as the best Go program, is an ideal playmate and tutor. Pournelle's game of the month *twice:* **"If you are interested in Go, buy this program."** BYTE 7/87

Toyogo, Inc.
76 Bedford St., Ste. 34Y, Lexington, MA 02173
(617) 861-0488

Inquiry 614.

FLOW CHARTS

FLOW CHARTING II+ HELPS YOU!

Precise flowcharting is fast and simple with **Flow Charting II+.** Draw, edit and print perfect charts: bold and normal fonts, 26 shapes — 95 sizes; fast entry of arrows, bypasses & connectors; Fast Insert Line; shrink screen displays 200-column chart; 40 column edit screen for detail work, much more!

PATTON & PATTON
81 Great Oaks Blvd., San Jose, CA 95119
1-800-525-0082 (Outside CA)
408-629-5376 (CA/Int'l)

Inquiry 615.

HARDWARE

CHIP CHECKER

- 74/54 TTL + CMOS
- 14/4000 CMOS
- 14-24 Pin Chips
- 8000 Nat. + Signetics
- 9000 TTL
- .3" + .6" IC widths

Tests/Identifies over 650 digital chips with ANY type of output in seconds. Also tests popular RAM chips. IBM compatible version $259. C128 + C64 version $159.

DUNE SYSTEMS
2603 Willa Dr., St. Joseph, MI 49085
(616) 983-2352

Inquiry 616.

PC CARDS/KITS

- 8 bit A/D card, 0-5V **$79**
- 8 bit D/A card, 0-2.5V **$79**
- Relay driver card, 8 outputs (3A) **$149**
- Digital I/O (8 TTL input/output) **$79**
- JB XT computer kit w/monitor **$499**
- FREE CATALOG—parts, kits, computers

JB COMPU-TRONIX
3816 N. Wadsworth Blvd., Wheat Ridge, CO 80033
(303) 425-9586

Inquiry 617.

HARDWARE/ADD-ONS

640K MotherBoard UPGRADE

640K RAM without using an expansion slot. Upgrades allow easy insertion of 256K chips on system board. Highly reliable due to reduced heat & chip count. 100% compatible. 30 day $ back guarantee, 2 yr. warranty. COMPAQ Portable, Zenith 151, 161: $29 + memory; IBM XT, Portable & 3270: $39 + memory; IBM PC; $49 + memory. Call for current memory prices. $4 s/h. Site discount, dealers welcome.

Aristo Computers, Inc.
6700 SW 105th Ave., #307-D, Beaverton, OR 97005
503/626-6333 **800/3ARISTO**

HARDWARE/COPROCESSORS

SC/FOX™ PARALLEL COPROCESSOR

PC/XT/AT/386 plug-in board with Forth software. 10 MIPS operation, up to 50 MIPS burst. 64K to 1M byte memory. Uses Harris RTX 2000™ RISC realtime CPU with 1-cycle multiply, 1-cycle 14-priority interrupts, two 256-word stacks, three 16-bit timer/counters, 16-bit i/o bus. Ideal for realtime control, signal and image processing and multiple board operation. From $1,995.

SILICON COMPOSERS, INC. **(415) 322-8763**
210 California Ave., Suite K, Palo Alto, CA 94306

Inquiry 618.

HYPERTEXT

Can Hypertext Help YOU?

You be the judge.

The Black Magic Hypertext Word Processor is now available as shareware. Version 1.2 includes support for CGA, EGA, VGA and Hercules graphics monitors. We'll send you the software on 3 disks, $15.95. Register for $79.95 and get printed manual, keyboard templates, quick ref card and 2 upgrades.

NTERGAID 2490 Black Rock Tpke. Suite 337
Fairfield, CT 06840 **(203) 368-0632**

LANS

Are you about to spend thousands of dollars for

Novell or 3-COM?

The invisible Network does the same thing, but costs only $249 per machine. True NETBIOS-compatible Local Area Network with high-speed 1.8 Mbps interface cards, cables, and *all* networking software. Works great with Multi-user dBASE, Clipper, QuickSilver, FoxBASE+, and all other file-sharing and multi-user software.

Database Specialties ***(415) 652-3630***
P.O. Box 2975, Oakland, CA 94618

THE BUYER'S MART

LAP TOP COMPUTERS

2 PC and 2pcLite

2 PC: Connects any two PC's for file transfer and communication. Features * 115,200 baud transfer rate * directory trees * chat mode * file tagging/viewing/deletion * print facility * universal cable * free cable wiring diagram (so you can "roll your own" cable!) * 3½" & 5¼" disks. **Complete - $55 (List: $80), without cable - $45. 2PC Lite:** Less Expensive, Works Great! **Complete - $40 (List: $50), without cable - $30.** Both programs have 43-line mode.

Cables sold separately: ser/par, kbd, mon, & others

Thompson Computing, 587F N. Ventu Park Road, Suite 306, Newbury Park, CA 91320, (805) 498-7653. VISA/MC add 4%.

Inquiry 619.

LAP-LINK

The ultimate solution for linking laptop computer with any IBM compatible desktop PC. 115, 200 baud transfer rate—faster than any other product available. No installation necessary, easy to use split screen design. Includes incredible "universal cable" that connects any two computers. Transfer entire disks faster than a DOS copy command! Only **$129.95** including universal cable and both 3½" and 5¼" disks. "Bridge" owners can trade in for only **$89.95** w/o cable.

Traveling Software, Inc.
19310 North Creek Parkway, Bothell WA 98011
1-800-343-8080 **(206) 483-8088**

Inquiry 620.

MARKETING

FREE BROCHURE & CATALOG

If you have a computer product that you're marketing...or thinking about marketing...we can help. We'll help you get free publicity from computer magazine editors, user groups and computer stores. Send for a free brochure today.

DP Directory, Inc.
525 Goodale Hill Road, Ste. 410, Glastonbury, CT 06033
(203) 659-1065

Inquiry 621.

MEMORY CHIPS

MEMORY CHIPS

41256-15-12-10	**Call**	51000 (1 Meg)	**Call**
4164-15	**Call**	51258 for Compaq 386	**Call**
4164-12	**Call**	8087-3-2	**Call**
41128 Piggy Back for AT	**Call**	80287-6-8-10	**Call**
41464-12 (64Kx4)	**Call**	80387	**Call**
414256 (256Kx4)	**Call**	NEC-V-20-8	**Call**
2764,27128,27256,27512	**Call**	Mouse	**Call**

Prices subject to change

ESSKAY ***718-353-3353***

Inquiry 622.

MONITOR INTERFACE

DRIVE MULTIPLE MONITORS

with one PC using our VOPEX video port expanders. Featuring no loss of resolution or color, presentations are more dramatic. We have a VOPEX for PC, PS/2, MAC II & workstations. Units are available from 2 to 10 output ports.

NETWORK TECHNOLOGIES INC.
800-RGB-TECH or 216-543-1646 **MC/VISA/AMEX**
19145 Elizabeth St., Aurora, OH 44202

Inquiry 623.

OPTICAL SCANNING

STOP TYPING!

OCR SERVICE BUREAU — We Scan **EVERYTHING**
Previously Printed Material
• Invoices • Books • Documents • Phone Bills
• Output to • 3½," • 5", • 8" • MAC •
1600 BPI • WORM • CD ROM
We Convert **EVERYTHING.**
All Word Processing and Data Bases Supported.
Kurzweil & Palantir Scanning
Phototypesetting & Printing • *Day & Night Service*

DATASCAN
1 World Trade Ctr., Ste. 1927, New York, NY 10048 **(212) 938-5727**

Inquiry 624.

PROGRAMMERS TOOLS

C or T Pascal Code Instantly

Complete database in just minutes. Draw & Paint your screen, show what fields to use for indexes—That's it—running source code in 6 seconds. Automatic context sensitive help, programmer docs on each program. $389/TPascal ver. or $499/TC or MS-C ver.

Call ASCII (800) 227-7681

Inquiry 625.

Simple Screens for C

New approach to screen handling in C lets you write programs fast! Ideal for business applications with numerous data entry screens. WYSIWYG screen design & maintenance. Popup windows & very simple function calls. Automatic field validation & data conversion. $50 with free upgrade in '89 to buyers in '88. IBM & compatibles. Turbo C, Microsoft C.

Dannenberg Software
4362 SE Old Orchard Ct., Milwaukie, OR 97267
503-659-2808

Inquiry 626.

FORTRAN NAMELIST EMULATOR

NAMLST™ subroutine library provides Fortran programmers with an emulation of NAMELIST and associated read and write routines. Supports Fortran 77 data types, 31 character names, control of output line length, tab stops, paging, plus features not found in compilers with NAMELIST statements. Popular Fortran 77 compilers. Literature available. Price $150.

Data Ready
4647 T Highway 280 E — Suite 150, Birmingham, AL 35242
(205) 991-6381

Inquiry 627.

PS Tools

(Postscript Printer Driver)

Generate reports & forms directly on your Postscript laser printer **without learning Postscript!** Output the easy to use commands with any programming language, word processor, or text editor. Position text, lines, boxes, rectangles, circles, etc. anywhere with any font and any font size. 50+ pages of documentation. MS-DOS $79.95 Others $89.95

Interactive Business Systems, Inc.
526 Robinhood Lane, McMurray, PA 15317
(412) 941-3648

Inquiry 628.

Get INSIDE!

INSIDE! is a powerful software performance analysis tool for popular PC compilers. INSIDE! measures the execution time of every function or procedure with microsecond accuracy or computes how often each source line is executed. Simply compile your application and INSIDE! does the rest. $75

Paradigm Systems Inc.
P.O. Box 152, Milford, MA 01757
(800) 537-5043 In MA: (508) 478-0499

Inquiry 629.

SAVE DEBUGGING TIME!

WATCH-I/O is a popup utility that shows names and technical info of all files in use. WATCH-I/O also shows name of last file opened, current program name, and last file-not-found.

Only $49.95 + $5 S&H Visa/MC/CK/MO

Quantum Publishing
23860 Miles Road, Cleveland, OH 44128
1-800-342-6237

Inquiry 630.

PUBLIC DOMAIN

OUTSTANDING IBM SOFTWARE

ONLY $2.75/DISK OR LESS

Our collection contains the latest versions of the Best Shareware and Public Domain Programs. Most are menu driven with full documentation. 3.50" format is also available. Orders shipped First Class Within 24 hours and Satisfaction is guaranteed. *Write for free printed catalogue or send a 25¢ stamp for a disk catalogue.*

A.C.L. **(916) 973-1850**
1621 Fulton Ave., Suite #35-B, Sacramento, CA 95825

Inquiry 631.

$3.00 SOFTWARE FOR IBM PC

Hundreds to choose from, wordprocessors, databases, spreadsheets, games, lotto, communications, business, music, bible, art, education, language and useful utilities for making your computer easier to learn. Most programs have documentation on the disk.

WRITE FOR YOUR FREE CATALOG TODAY!

BEST BITS & BYTES
P.O. Box 8245, Dept-B, Van Nuys, CA 91409
In CA: (818) 781-9975 **800-245-BYTE**

Inquiry 632.

RENT SOFTWARE $1/DISK

Rent Public Domain and User Supported Software for $1 per diskfull or we'll copy. IBM (3½" also), Apple, C-64, Sanyo 550 and Mac. Sampler $3. VISA/MC. **24** hr. info/order line. (619) 941-3244 or send #10 SASE (specify computer) Money Back Guarantee!

FutureSystems
Box 3040 (T), Vista, CA 92083
office: 10-6 PST Mon.-Sat. **(619) 941-9761**

Inquiry 633.

$4.00 SHAREWARE $4.00

IBM-PC Compatible Software

- Over 700 Disks to Choose From
- Not Half Full Like Some Distributors
- Dozens of Programs in All Categories

Call or Write for FREE Catalog on Disk
— Please specify 5¼" or 3½" Disk —

The Software Kingdom
P.O. Box 555, Auburn, NH 03032-0555
1-800-552-DISK (In N.H.) (603) 483-5055

Inquiry 634.

SECURITY

TOTAL PRIVACY $49

Powerful data protection for PC/AT—documents, databases, spreadsheets—any data. The Diary's DES and Ultra Fast encryption keep the curious out. Menu and command line modes. Comprehensive Help. Clear manual starts you quickly. **$49** Introductory price. **$10** Demo. VISA/MC/COD. 90 day money back guarantee.

DIARY **1-800-87-DIARY**
Toll Free Information 24 Hours a Day
Or write, P.O. Box 70443, Bellevue, WA 98007

Inquiry 635.

Security Kits • Cust Cables

PC Lock secures PC, XT, PS2, & clones, including base, monitor, keyboard, & most peripherals & boards. Attractive red vinyl 8′ covered steel cables. Lock incl. No tools req. $back guarantee. $49.95 + $4s/h. Special kits also avail. for Mac & many others. Any length custom cables connect any devices. Std. 8′ $29.95.

Mac Products
20231 San Gabriel Valley Dr., Walnut, CA 91789
714/595-4838

Inquiry 636.

THE BUYER'S MART

SECURITY

COPY PROTECTION

The world's leading software manufacturers depend on Softguard copy protection systems. Your FREE DISKETTE introduces you to SuperLock™—invisible copy protection for IBM-PC (and compatibles) and Macintosh.

- Hard disk support
- Customized versions
- No source code changes
- LAN support
- New upgrades available

(408) 773-9680

SOFTGUARD SYSTEMS, INC.
710 Lakeway, Suite 200, Sunnyvale, CA 94086
FAX (408) 773-1405

Inquiry 637.

SMALL BUSINESS SYSTEMS

SMALL BUSINESS SYSTEMS

Finally, a complete computer system classroom designed and field tested with the Small Business Owner in mind. Business capital of America we proudly present "The Y.E.S.! Collection"(c) (*Your Efficiency System*). Several modules written by New England's Ross Ballard II. If you are starting a new business or have been in business for less than two years, and can work with professional trainers via telephone then the Y.E.S.!(c) curriculum is for you. Choose from our "Starting a New Venture", "The Home Based Business", or "Women in Business" each built around NCR Hardware and our unique accounting software that we help you customize. Ask yourself if your business deserves the best then say "Y.E.S.!" Write or call now for our *free* brochure.

ALTERNATIVE BUSINESS TRAINING, INC.
206 Washington Street, Keene, NH 03431
1-800-328-7677 *(In NH 357-5111)*

Inquiry 638.

SOFTWARE/ACCOUNTING

BILLING+PAYROLL = $199

ABP combines timekeeping, billing, and payroll function into one simple, easy to use software package. The user simply needs to enter timesheet information. Invoices and/or checks are then automatically available for printing directly off our system.

ASHLEY SOFTWARE
5010 North Bridges Drive, Alpharetta, GA 30201
(404) 475-2930

Inquiry 639.

dBASE BUSINESS TOOLS

* General Ledger
* Accounts Recvbl.
* Order Entry
* Sales Analysis
* Purch Ord/Invntory
* Accounts Payable
* Job Costing
* Job Estimating

$99 EA. + s&h w/dBASE 2, 3 or 3+ SOURCE CODE

dATAMAR SYSTEMS™ Cr. Crd/Chk/COD
4876-B Santa Monica Ave.
San Diego, CA 92107 **(619) 223-3344**

Inquiry 640.

SOFTWARE/BASIC

XGRAF DRAWS IN BASIC!

FINALLY! XGRAF replaces QuickBASIC's poor drawing commands with assembly language calls that work on *Hercules*, EGA, VGA, CGA and EEGA screens. Only $99.00 + $4.00 S&H. Call us at **1-800-423-3400** (9:00 AM to 8:00 PM EST)

KOMPUTERWERK, INC.
851 Parkview Blvd., Pittsburgh, PA 15215
For info., call (412) 782-0384

Inquiry 641.

SOFTWARE/BUSINESS

DATA ENTRY SYSTEM

Heads-down data entry with two-pass verification for the PC/XT/AT - PS/2 & compatibles. Loaded with features like: Auto dup & skip, verify bypass, range checks, & table lookups. Fully menu driven only $395.

Call for free 30 day trial period.

COMPUTER KEYES
21929 Makah Rd., Woodway, WA 98020
(206) 776-6443 1-800-356-0203

SOFTWARE/BUSINESS

LP88-SPREADSHEET LP

Our best-selling menu-driven linear programming system now solves problems with 1000 constraints and 5000 variables up to 30 times faster. New version reads/writes Lotus worksheets. Use 1-2-3/Symphony as a matrix generator or post processor. Many other features including interactive and batch operation, spreadsheet-style display, equation processor, problem/basis storage, file I/O, Simplex restart, report generator, sensitivity analysis. *IENews* says: "The flexibility and features of this program are a bargain at its low price." $149 with 8087 support and 100-page manual. $29 for working demo and manual.

EASTERN SOFTWARE PRODUCTS, INC.
P.O. Box 15328, Alexandria, VA 22309 **(703) 360-7600**

Inquiry 642.

dFELLER Inventory

Business inventory programs written in modifiable dBASE source code.

dFELLER Inventory **$150.00**
Requires dBASE II or III, PC-DOS/CPM
dFELLER Plus **$200.00**
with History and Purchase Orders
Requires dBASE III or dBASE III Plus (For Stockrooms)

Feller Associates
550 CR PPA, Route 3, Ishpeming, MI 49849
(906) 486-6024

Inquiry 643.

FINANCE MANAGER II

Easy to learn, fully integrated, menu-driven bookkeeping system for small business and personal use. IBM PC, XT, AT, PS/2 or compatible. **Try before you buy!** General Ledger evaluation copy for only $10!

CALL TODAY! (719) 528-8989
HOOPER INTERNATIONAL: PO Box 62219, Colorado Springs, Colorado 80962

Inquiry 644.

1-2-3® + @RISK = Risk Analysis

Manage risk with @RISK 1-2-3 Add-In! An @RISK simulation automatically reflects thousands of "what-if" scenarios. ■ View full range of possible outcomes ■ Monte Carlo simulation ■ Graphs in .PIC format ■ 30 new probability distribution @functions *Now required for all Harvard MBAs*

FREE DEMO

Palisade Corporation
2189 Elmira Road, Newfield, NY 14867
(607) 564-9993

Inquiry 645.

The Executive Assistant™

New E-Z software for bogged-down secretaries & hands-on executives doing pro-active people networking. Slash clerical time. Menu—44 user data fields—instant auto typed, addr's std letters, envelopes—labels, reports—note pad, ticklers, phone work, merge—MORE. INTRODUCTORY OFFER—$100 off $249 price. IBM, 384K, HD. Send only **$149** (or $20 for working demo) to:

Parkside Computer Systems(714) 838-1888
1241 Landfair, Santa Ana, CA 92711 Visa/MC

Inquiry 646.

SOFTWARE/CHURCH

PowerChurch Plus®

Fast, friendly, reliable church administration system. Full fund accounting, mailing lists, membership, contributions, attendance, word processing, accts. payable, payroll, multi-user support, and much more - all for $695 complete. FREE demo version.

F1 SOFTWARE
P.O. Box 3096, Beverly Hills, CA 90212
(213) 854-0865

Inquiry 647.

SOFTWARE/ENGINEERING

PRACTICAL ENGINEERING TOOLS

Hobbyists—Students—Engineers

CIRCUIT DESIGN_CompDes, menu selections from basic electricity through circuit designs.
MATHEMATICS_CompMath, menu selections from general math through statistics.
ANALYSIS_CompView. Fourier Analysis of waveforms and filters. PC/MSDOS. $49 each. VISA/MC

BSOFT SOFTWARE (614) 491-0832
444 Colton Rd., Columbus, OH 43207

Inquiry 648.

VERSATILE DSP & DISPLAY

PC DATA MASTER is a DOS shell which integrates a full set of signal processing functions: flexible graphics, data file math, DSP utilities, data sampling/generation, and interactive help. Support for CGA, EGA, VGA, Herc & AT&T. Add custom analysis or graphics functions easily using your favorite compiler. **$135. Toolkit $45. Demo $10.**

Durham Technical Images
P.O. Box 72, Durham, New Hampshire 03824-0072
(603) 868-5774

Inquiry 649.

• COMPOSITE ANALYSIS •

Menu driven program for analyzing composite laminates.

- Calculates fiber stresses & strains
- Graphical strength ratios
- Database includes Graphite, Kevlar & Fiberglass
- SI/US units; thermal & moisture effects

Send check/MO for $225 or $3 for demo disk to:

GS composites
7627 E.37th N. #706, Wichita, KS 67226

Inquiry 650.

SIMULATION WITH GPSS/PC™

GPSS/PC™ is an IBM personal computer implementation of the popular mainframe simulation language GPSS. Graphics, animation and an extremely interactive environment allow a totally new view of your simulations. Simulate complex real-world systems with the most interactive and visual yet economical simulation software.

MINUTEMAN Software
P.O. Box 171/Y, Stow, Massachusetts, U.S.A.
(508) 897-5662 ext. 540 (800) 223-1430 ext. 540

Inquiry 651.

FREE ENGINEERING MAGAZINE

Personal Engineering is a monthly magazine sent free of charge (USA only) to scientists/engineers who use PCs for technical applications. Topics each month include **Instrumentation • Data Acq/Control • Design Automation.** To receive a free sample issue and qualification form either circle below or send request on letterhead to:

Personal Engineering Communications
Box 1821, Brookline, MA 02146

Inquiry 652.

SOFTWARE/GENERAL

★★ *FREE SOFTWARE CATALOGUE* ★★

Most popular selling software and computer products. Borland, Lotus, Xerox, Norton, User Supported and More. 10 DS/DD 5.25 DISK 3.75, DISK CASE 2.49, 1000 LABELS 4.95, PAPER, RIBBON, POST CARDS, ROLODEX CARDS, +P&H

Mort	Calculates amount of home mortgage	24.95
Plabel	Prints continuous 3.5 × 15/16 labels	9.95
Twrite	Turns your printer into a typewriter	9.95
Pmode	Sets 1 of 28 fonts for Epson & dot matrix	9.95

This issue special Plabel, Twrite, Pmode all 3 for 9.95

THE SOFTWARE HUT
P.O. Box 613, Bantam, CT 06750

Inquiry 653.

THE BUYER'S MART

SOFTWARE/GEOLOGICAL

GEOLOGICAL CATALOG

Geological software for log plotting, gridding/contouring, hydrology, digitizing, 3-D solid modelling, synthetic seismogram, fracture analysis, image processing, scout ticket manager, over 50 programs in catalog. Macintosh too! Please call, or write, for Free Catalog!

RockWare, Inc.
4251 Kipling St., Suite 595, Wheat Ridge, CO 80033 USA
(303) 423-5645

SOFTWARE/GRAPHICS

PC TECHNICAL GRAPHICS

TEKMAR is a graphics library for the **EGA** or Tecmar Graphics Master. Similar to PLOT-10, includes WINDOW, VIEWPORT, AXIS. Support for HP, HI plotters. Curve fitting, complete plotting program. Log, semi-log, multi-axis, 3-D, contours. Jerry Pournelle (Aug 86 *Byte*): "As good as any I have ever seen..." Demo disks, literature available.

Advanced Systems Consultants
21115 Devonshire St. #329, Chatsworth, CA 91311
(818) 407-1059

Inquiry 654.

TurboGeometry Library

Over 150 2&3 dimensional routines, includes Intersections, Transformations, Equations, HiddenLines, Perspective, Curves, Areas, Volumes, Clipping, Planes, Vectors, Distance, Polydecomp, IBM PC and Comp. MAC. MSDOS 2+. Turbo Pascal, Turbo C, MSC & Turbo Pascal MAC. 400 pg. manual, source code. $149.95 + 5.00 S&H. VISA, MC, Chk, PO. 30 Day guarantee.

Disk Software, Inc.
2116 E. Arapaho #487, Richardson, TX 75081
(214) 423-7288

Inquiry 655.

S E G S

SCIENTIFIC & ENGINEERING GRAPHICS SYSTEM

See "What's New" pg 82, BYTE June, 1988
Log, Data & Linear Axes; Curve Fitting & Smoothing 1-2-3 Interface; Numeric Spreadsheet. Supports all Video Standards, PC Printers & Plotters. 10 Curves w/5000 points each. Plus much more. Call Today.

Edmond Software
3817 Windover Drive 1-405-842-0058
Edmond, Oklahoma 73013 1-800-992-3425

Inquiry 656.

FPLOT PEN PLOTTER EMULATOR

Use your dot matrix or laser printer as an HP pen plotter. Fast hi-res output. Vary line width. Includes VPLOT virtual plotter utility to capture plotting commands. Supports NEC P5/P6, IBM Proprinter, Epson LQ/MX/FX, HP Laserjet. Uses Hercules, CGA, EGA or VGA for screen preview. $64 check or m.o.

FPLOT CORPORATION
Suite 605, 24-16 Steinway St., Astoria, NY 11103
212-418-8469

Inquiry 657.

GRAPHICS PRINTER SUPPORT

AT LAST! Use the PrtSc key to make quality scaled B&W or **color** *reproductions of your display on any dot matrix, inkjet, or laser printer. GRAFPLUS supports* **all** *versions of PC or MS-DOS with IBM (incl. EGA, VGA), Tecmar, and Hercules graphics boards. $49.95.*

Jewell Technologies, Inc.
4740 44th Ave. SW, Seattle, WA 98116
800-628-2828 x 527(206) 937-1081

Inquiry 658.

SOFTWARE/GRAPHICS

FORTRAN PROGRAMMER?

Now you can call 2-D and 3-D graphics routines within your FORTRAN program.

GRAFMATIC: screen routines	$135.
PLOTMATIC: plotter driver	135.
PRINTMATIC: printer driver	135.

For the IBM PC, XT, AT & compatibles. *We support a variety of compilers, graphics bds., plotters and printers.*

MICROCOMPATIBLES
301 Prelude Dr., Dept. B, Silver Spring, MD 20901 USA
(301) 593-0683

Inquiry 659.

35mm SLIDE FROM YOUR PC

COMPUTER SLIDE EXPRESS converts graphic files produced on the IBM PC into brilliant 35mm color slides with color resolution 400% better than your monitor. Leave your printouts behind. Use high resolution color slides up to 4000 line.

COMPUTER SLIDE EXPRESS **$9/slide**

VISUAL HORIZONS
180 Metro Park, Rochester, NY 14623
(716) 424-5300

Inquiry 660.

SOFTWARE/HEALTH

MEDICAL-DENTAL SOFTWARE

American Medical Software's Medical-Dental Office Management Systems ($2,495) and Office Billing Systems ($1,495) are easy to use on any IBM PC-XT-AT-PS/2 or compatible. Multi-user capabilities and exceptional support services are standard. IBM or TANDY computers, at substantial savings, and financing available with each software purchase. Accumulative Discount Policy for AMS approved Value Added Resellers! Call for additional information or demo diskette.

AMERICAN MEDICAL SOFTWARE
P.O. Box 236, Edwardsville, IL 62025
800-423-8836 **618-692-1300**

Inquiry 661.

SOFTWARE/LANGUAGES

FORTHWITH DRUMA FORTH-83

Powerful. Well designed. User friendly. Attractively priced. Enhance productivity. Reduce development time.

- No 64K limit, 16 bit speed to 320K, 1Mb+ memory.
- On-line doc/glossary, full DOS & file interface.
- Assembler, editor, examples, many utilities

15 day unconditional guarantee. From $79, S&H $2, VISA/MC. IBM PC/XT/AT & **all compatibles.** Other packages: **Inquire**

DRUMA INC.
6448 Hwy. 290 East E103, Austin, TX 78723
Orders: 512-323-0403 **BBoard: 512-323-2402**

Inquiry 662.

SUBPROGRAM LIBRARIES

Five volumes of source code: Math, Statistics, Graphics, DOS & BIOS & I/O functions. Spectroscopy. Up to 98% less user code with our fully tested library. Manuals with examples guarantee fast success. Portability insured for BASIC, PASCAL under MS-DOS, Mac-OS, VMS, HP300. Prices start $145 per volume. 30 day $ back. VISA/MC/P.O.

Scientific LOGICS, Inc.
21910 Alcazar Ave., Cupertino, CA 95014
Ph.# 408-446-3575 ***Compuserve 74017,663***

Inquiry 663.

SOFTWARE/PACKAGING

HARD TO FIND COMPUTER SUPPLIES FOR SOFTWARE DEVELOPERS & POWER USERS

Cloth binders & slipcases like IBM's. Vinyl binders, boxes, and folders in many sizes. Disk pages, envelopes, & labels. Low quantity imprinting. Bulk disks. Everything you need to bring your software to market. Disk and binder mailers. Much more! Low Prices! Fast service. Call or write for a **FREE CATALOG.**

Anthropomorphic Systems, Limited
376 E. St. Charles Rd., Lombard, IL 60148
1-800-DEAL-NOW **312-629-5160**

Inquiry 664.

SOFTWARE/SALES & MKTG.

FOLLOW-UP

SOFTWARE FOR SALESPEOPLE

Manage & control all of your sales activities
on your desktop or laptop.

$179.95

XYCAD GROUP
1577 St. Clair Ave., Cleveland, OH 44114
(800) 428-8457 **(216) 589-5788 in Ohio**

Inquiry 665.

SOFTWARE/SCANNERS

Optical Character Recognition

Stop retyping: PC-OCR™ software will convert typed or printed pages into editable text files for your word processor. Works with HP ScanJet, Panasonic and most other scanners. Supplied with 18 popular fonts. User trainable: you can teach PC-OCR™ to read virtually any typestyle, incl. foreign fonts. Proportional text, matrix printer output, Xerox copies OK. $385. Check/VISA/MC/AmExp/COD

Essex Publishing Co.
P.O. Box 391, Cedar Grove, NJ 07009
(201) 783-6940

Inquiry 666.

SOFTWARE/SCIENTIFIC

DATA ACQUISITION & ANALYSIS ON PC'S

- Free application assistance. Tell us about your DSP, process control, A/D or D/A needs. Our expert engineering staff will provide you with a system solution to fit your needs and budget.
- A/D & IEEE 488 boards from MetraByte, Scientific Solutions and Analog Devices.
- Analysis software including PRIME FACTOR FFT subroutine library, FOURIER PERSPECTIVE II advanced linear systems analysis.
- Menu driven software from Unkel, Laboratory Technologies, Quinn-Curtis, and Golden. Scientific/engineering 2 & 3D graphics.

See "**What's New**" page 80, BYTE July, 1988
LOW PRICES—Satisfaction GUARANTEED

ALLIGATOR TECHNOLOGIES
P.O. Box 9706, Fountain Valley, CA 92708
Tel. (714) 850-9984 **FAX. (714) 850-9987** **MCI. ALLIGATOR**

Inquiry 667.

POWERFUL EQN SOLVER

$99 RISK FREE OFFER WITH FREE WORD PROCESSOR!

• "A real Bargain" *IEEE* • "Dev. over 40 years by aerospace vets" *EE TIMES* • "Defines new functions" *Eng'g Tools* **CURVE™** • Graph results ACROSS SINGULARITIES • Change parameters/conditions • Fit 60th order curves to imported data • COMPLEX/real roots • Diff Eq • Indefinite Integrals • More • MS-DOS, 640k, graphics card

Call Today! 800/621-0849 x 330
8:30–5:30 PTime • VISA/MC/AMEX/Check

Curve System International
747 Moreno Ave., LA, CA 90049

Inquiry 668.

Chaos/Nonlinear Dynamics

Tools for Studying Mathematical and Experimental Systems

* Ordinary and Delay Differential Equation Solvers * Bifurcation Diagrams * 2- and 3-D Plotting, Sequential Magnification, Poincaré Sections * Next Maximum, 1-D & Circle Maps * Phase Portraits with Multiple Initial Conditions * Spectral Analysis, Fractal Dimensions, Lyapunov Exponents

DS:I $250.00 DS:II $350.00

DYNAMICAL SYSTEMS, INC.
P.O. Box 35241, Tucson, AZ 85740, 602-825-1331

Inquiry 669.

IBM PC DATA ACQUISITION

No Programming Required!
Flexible, integrated systems for
data acquisition, analysis, control,
digital filtering, streaming, and decision making.
Demo disks upon request. Contact:

HEM Data Corporation
17336 12 Mile Rd. #201, Southfield, MI 48076
(313) 559-5607

Inquiry 670.

THE BUYER'S MART

SOFTWARE/SCIENTIFIC

FAST FOURIER TRANSFORMS

- Subroutine for integer data: 1024 points in 44mSec on PS-2/Mod 80.
- Subroutine for floating-point data: (with 80387) 1024 points in 220 mS.
- NEW subroutine for double-precision data: 1024 points in 157 mSec!
- Call from FORTRAN, C, BASIC, Pascal.

Check or PO: $175 ea/$350 all three.

J.W. Hartwell & Associates
Route 4 Box 1540, Hillsborough, NC 27278**(919) 732-7951**

Inquiry 671.

ORDINARY/PARTIAL DIFFERENTIAL EQN SOLVER

FOR THE IBM PC & COMPATIBLES

MICROCOMPATIBLES INC.
301 Prelude Dr., Silver Spring, MD 20901
(301) 593-0683

Inquiry 672.

"powerful and easy to use..."

Ask for our *free* 16 page brochure with complete product descriptions and detailed technical application notes (and for a brief description of two of our products see "What's New", Byte, page 84, July/88).

MicroMath Scientific Software
2034 East 7000 South
Salt Lake City, Utah 84121-3144
(801) 943-0290

Inquiry 673.

Scientific Software

Scientific CALCULATOR parallel processing & graphics, **Sci.NOTEPAD** free-form data management, **DIALSEARCH** literature searches, **SCI.GRAPHPAD** and **SCI.STATPAD** graphics-aided data analysis (log/semilog plots, error bars, curve fit, more). From $85- On 5¼ and 3½" MS-DOS disks. 30 day $ back. VISA/MC/P.O. Also see our ad under LANGUAGES.

Scientific LOGICS Inc.
21910 Alcazar Ave., Cupertino, CA 95014
(408) 446-3575 Compuserv 74017,663

Inquiry 674.

SOFTWARE/SORT

OPT-TECH SORT/MERGE

Extremely fast Sort/Merge/Select utility. Run as an MS-DOS command or CALL as a subroutine. Supports most languages and filetypes including Btrieve and dBASE. Unlimited filesizes, multiple keys and much more! MS-DOS **$149.** XENIX **$249.**

(702) 588-3737

Opt-Tech Data Processing
P.O. Box 678 - Zephyr Cove, NV 89448

Inquiry 675

SOFTWARE/TAX PREP

FORECAST 1988 TAXES

Start with 1987 return, make changes for 1988, compute 1988 return. New tax law changes and 1988 tax tables. 228 page User Guide and Tax Reference Manual. For IBM/compatible personal computers, DOS 2.0+, 256K, 5.25" disk. $24.95 + $3 s/h. MA add $1.25 tax. Check, MO, MC, V only.

Quality Business Systems
P.O. Box 805, Hudson, MA 01749
1-800-225-5800

Inquiry 676.

SOFTWARE/TOOLS

NATURAL LANGUAGE SOFTWARE

Use JAKE to create a front end to your database, game, or graphics program! JAKE translates English queries and commands into C function calls and data structures. JAKE offers context-sensitive semantic processing; interfaces easily; <64K mem.

$495. INTERACTIVE DEMO $10

ENGLISH KNOWLEDGE SYSTEMS, INC.
5525 Scotts Valley Dr. #22, Scotts Valley, CA 95066
(408) 438-6922

Inquiry 677.

SCREEN MANAGER

MENU, WINDOW, and DATA ENTRY Support for the Professional Programmer! Interfaces to most languages. BASIC, C, FORTRAN, COBOL, PASCAL, ASSEMBLER. 100 Page Manual. Thirty day money back guarantee. No Royalties.

from $79. Visa/MC

The West Chester Group
P.O. Box 1304, West Chester, PA 19380
(215) 644-4206
CALL FOR FREE DEMO

Inquiry 678.

STATISTICS

STATISTICS CATALOG!

If you need statistics for IBM PC or Apple II, call us and let our technical advisors help you find the statistics programs you need.

Write or call now to get a FREE catalog of statistics and quality control software.

HUMAN SYSTEMS DYNAMICS
9010 Reseda Blvd., Ste. 222
Northridge, CA 91324
(800) 451-3030 (818) 993-8536 (CA)

Inquiry 679.

StatPac Gold™

Voted World's Best Statistical & Forecasting Package in 1987 by PC World Magazine readers. Six times more votes than the next closest competitor. More comprehensive & easier to use than all others. Get the facts. Call now for your FREE brochure.

1-800-328-4907

Walonick Associates, Inc.
6500 Nicollet Ave. S., Minneapolis., MN 55423
(612) 866-9022

Inquiry 680.

TERMINAL EMULATORS

Datapoint Terminal Emulators

Increase the usefulness of your personal computer and Datapoint investment. Connect your PC or PC clone with any Datapoint computer. Full terminal emulation, file transfer, and MS/DOS hot key, while using DOS or RMS. Requires only IBM compatible and async comm adaptor. Full source code available. 8242, 8220 or 3600 terminal emulators. $179.95 ea.

MC/Visa/COD **(206) 391-3725**

LAN Comp Systems
14524 Issaquah-Hobart Rd., Issaquah, Washington 98027

Inquiry 681.

UTILITIES

BEAUTY FOR YOUR BEAST

ELEGANT INTERFACE TO DOS. Faster more powerful version of this popular DOS shell. Find, copy, move, delete files in a few keystrokes. *Tagging. *Find on name and text. *Full Tree. *User defined commands and more. $39 complete with 160pp. manual. Unltd. site lic. $390. MC/VISA. 90-Day No-Risk Guarantee.

BILL WHITE
PO Box 57, Still River, MA 01467
(508) 456-3699

Inquiry 682.

UTILITIES

MATCH PRINTERS TO PC

For less than $30 **MatchFont** and **Match-a-Printer** are great for foreign and scientific writings. Get all the characters you need from most programs and printers (Apple & Epson printers, daisywheels, etc.). Greek, French, Italian, Spanish, German, Swedish, Japanese, graphics . . . You name it! To receive a **FREE** demo disk use the inquiry # below or write to:

MATCH SOFTWARE
6426 Coldwater Canyon, North Hollywood, CA 91606-1113

Inquiry 683.

COPY AT TO PC

The 1.2mB drive has long been known to READ but NOT reliably WRITE on 360kB floppies. With **"CPYAT2PC"™** 1.2mB drives CAN reliably WRITE 360kB floppies saving a slot for a second hard disk or backup tape. "CPYAT2PC" (Not Copy Protected) offers 'the preferable SOFTWARE SOLUTION.' *ONLY $79+$4* S/H VISA/MC/COD UPS B/R

MICROBRIDGE COMPUTERS
655 Skyway, San Carlos, CA 94070
Order toll free **1-800-523-8777**
415-593-8777 (CA) **212-334-1858 (NY)**
TELEX EZLNK 62873089 FAX 415-593-7675

Inquiry 684.

The NOVA UTILITIES

Twelve advanced DOS programs that are on every user's wish list. Disk editor, file recovery, point-and-shoot window directory manager, encrypt and compress files, DOS command line qualifiers, find, view, delete, move, copy, more! *Less than $6 per program* at only **$69.95** complete with 100+ page manual.

NOVA SOFTWARE, Inc.
P.O. Box 37464, Albuquerque, NM 87176 **(505) 836-8400**

Inquiry 685.

Recover deleted files fast!

Disk Explorer now includes automatic file recovery. You type in the deleted file's name, Disk Explorer finds and restores it. Disk Explorer also shows what's really on disk; view, change or create formats, change a file's status, change data in any sector. MS-DOS **$75** U.S. Check/Credit card welcome.

QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

WORD PROCESSING

PC-Write™ Shareware Ver. 2.71

Fast, full featured word processor/text editor for IBM PC. With spell check, screen clip, mailmerge, split screen, ASCII files, macros. Easy to use. Supports 400 printers - LaserJet+ and PostScript. Software, User Guide, and Tutorial on 2 disks for $16. Try it, then register with us for only $89 and get User Manual, 1 year tele-support, newsletter and 2 upgrades. 90-day guarantee. VISA/MC.

Quicksoft **1-800-888-8088 CALL TODAY!**
219 First N., #224-BYTC, Seattle, WA 98109

Inquiry 686.

Laser Print Envelopes!

The Star★Lite™ Laser Envelope Printer software produces envelopes as professional as your correspondence. Version 2.0 supports 20+ envelope styles, multiple return addresses and more! Compatible with all popular word processing software and almost any laser printer. Requires PC or compatible, 10K memory. $89 + S&H.

TSG Technical & Systems Group, Inc.
P.O. Box 95 Streetsville, Mississauga, Canada L5M 2B7
(416) 858-1885

Inquiry 687.

Mail Order Electronics · Worldwide
Jameco ELECTRONICS

Mail-Order Electronics

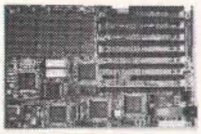
24 HOUR ORDER HOTLINE 415-592-8097

CUSTOMER SERVICE (7AM-5PM PST) 415-592-8121

SALE! IBM COMPATIBLE ACCESSORIES *NEW!*

Jameco IBM PC/XT/AT Compatible Motherboards

- AMI BIOS ROMs included


JE3005 Pictured

JE1001	4.77/8MHz (PC/XT)	**$89.95**
JE1002	4.77/10MHz (PC/XT)	**$109.95**
JE3005	8/12MHz (AT)	**$329.95**

Jameco IBM PC/XT/AT Compatible Computer Cases

JE1019 Pictured

JE1010	Standard PC/XT Flip-Top Case	**$34.95**
JE1011	Standard PC/XT Slide Case	**$39.95**
JE1014	Baby XT Turbo Flip-Top Case	**$69.95**
JE1018	Baby AT Slide Case	**$69.95**
JE1019	Baby AT Flip-Top Case	**$69.95**

Jameco IBM PC/XT/AT Compatible Power Supplies

JE1032 Pictured

PC/XT (150 Watt): +5V @ 15A, −5V @ 0.5A, +12V @ 5.5A, −12V @ 0.5A

AT (200 Watt): +5V @ 20A, −5V @ 0.5A, +12V @ 8A, −12V @ 0.5A

JE1030	Std. Size PC/XT	~~$69.95~~ **$59.95**
JE1031	Baby PC/XT	**$69.95**
JE1032	Baby AT	**$89.95**

Jameco IBM PC/XT/AT Compatible Keyboards

JE1016 Pictured

JE1015	Standard AT layout (XT/AT)	**$59.95**
JE1016	Enhanced layout (XT/AT)	**$69.95**

LOGITECH 2 and 3 Button Mice for IBM PC/XT/AT

- Utilizes opto-mechanical technology
- Includes driver software
- Serial or Bus Card Versions available
- Fully compatible w/ all mouse based applications

M8 Pictured

M8	2-Button, Serial Mouse	**$49.95**
C7PLUS	3-Button, Serial Mouse	**$79.95**
BUS	3-Button, Bus Mouse	**$79.95**

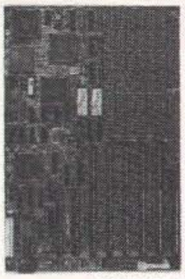
RAM, V20 & Intel Math Coprocessors

*4164-150	65,536x1 (150ns)	$2.89
*41256-100	262,144x1 (100ns)	$13.25
*41256-120	262,144x1 (120ns)	$12.95
*41256-150	262,144x1 (150ns)	$12.25
UPD70108-5	(5MHz) V20 Chip (Replaces 8088)	$7.49
UPD70108-8	(8MHz) V20 Chip (Replaces 8088 or 8088-2)	$10.75
8087-2	Math Coprocessor PC/XT and Compatibles (8MHz)	$159.95
80287-10	Math Coprocessor AT and Compatibles (10MHz)	$309.95
80387-16	Math Coprocessor 386 (16MHz)	$474.95
80387-20	Math Coprocessor 386 (20MHz)	$749.95
*511000P-10	1,048,576x1 (100ns)	$39.95

IBM AT Compatible 16MHz 80286 NEAT Motherboard

- Expandable to 1MB RAM using 256K DRAM chips or 4MB using 1MB DRAM chips
- Additional 1MB with 256K DRAM SIPs or 4MB with 1MB DRAM SIPs for a total of 8MB
- 8/12 or 8/16MHz hardware or keyboard selectable
- Front panel LED indicators supported
- Six 16-bit and two 8-bit expansion bus slots
- AMI BIOS ROMs included
- Supports all *NEAT* functions including shadow RAM, EMS 4.0, RAM re-mapping, selectable wait states, etc.
- 80287-10 Math Coprocessor capability
- Norton SI rating of 15.6
- Size: 13" x 8.5"
- Weight: 2.25 lbs.

One Year Warranty!



Latest Technology!

JE3010 8/12/16MHz AT Comp. Motherboard **$499.95**

IBM COMPATIBLE DISPLAY MONITORS

12" Amber Monochrome — TTL Input, High Resolution (PC/XT/AT)
AMBER **$99.95**

14" RGB Color — CGA Compatible Amber/Green/Color Switchable, 640 x 200 Resolution (PC/XT/AT)
CTX2410 **$279.95**

JEVGA (card included)

14" EGA Color - EGA/CGA Compat., 720 x 350 Max. Resolution (PC/XT/AT)
TM5154 **$399.95**

14" Multiscan Color - VGA/PGC/EGA compatible, 800 x 600 Max. Resolution (PC/XT/AT)
TM5155 **$549.95**

EGA/VGA MONITOR AND CARD SPECIALS

14" EGA Monitor and EGA Card - EGA compatible, 720 x 350 Max. Resolution — displays up to 16 colors (PC/XT/AT)
JE1059 ***SAVE $40.00!*** **$519.95**

13" VGA Monitor and VGA Card - VGA compatible, 800 x 560 Max. Resolution — displays up to 256 colors (PC/XT/AT)
JEVGA **$649.95**

JAMECO IBM PC/XT/AT COMPATIBLE CARDS

Graphic Display Cards

MGA, CGA or EGA!

JE1050

JE1050	Mono Graphics Card w/Printer Port (PC/XT/AT)	**$59.95**
JE1052	Color Graphics Card w/Printer Port (PC/XT/AT)	**$49.95**
JE1055	EGA Card w/256K Video RAM (PC/XT/AT)	~~$169.95~~ **$159.95**
JE1071	Multi I/O with Drive Controller and Mono Graphics (PC/XT)	**$119.95**

Multifunction, I/O and Expansion Cards

JE1060	I/O Card with Serial, Game, Parallel Printer Port and Real Time Clock (PC/XT)	**$59.95**
JE1061	RS232 Serial Half Card (PC/XT)	**$29.95**
JE1065	I/O Card with Serial, Game and Parallel Printer Port (AT)	**$59.95**
JE1078	Expand to 384K (zero-K on-board) Multifunc. w/Serial, Game, Parallel Printer Port & Real Time Clock (PC/XT)	**$69.95**
JE1081	2MB of expanded or extended memory (zero-K on-board) (AT)	**$119.95**
JE1082	3MB of expanded or extended memory, parallel printer port, serial port and game port (zero-K on-board) (AT)	**$169.95**

Floppy and Hard Disk Controller Cards

JE1040	360KB Floppy Disk Drive Controller Card (PC/XT)	**$29.95**
JE1041	20/40MB Hard Disk Controller Card (PC/XT)	**$79.95**
JE1043	360K/720K/1.2MB/1.44MB Floppy Disk Cont. (PC/XT/AT)	**$49.95**
JE1045	360K/720K/1.2MB/1.44MB Floppy/Hard Disk Controller Card (AT)	**$149.95**

IBM PC/XT and AT Computer Kits also available!

3.5" PC/XT/AT Compatible Disk Drives

SALE

MF355B Pictured

MF353B	3.5" 720KB (Bezels and Installation Kit incl.) (PC/XT/AT)	~~$129.95~~ **$109.95**
MF355B	3.5" 1.44MB (Bezels and Installation Kit incl.) (PC/XT/AT)	~~$149.95~~ **$129.95**

Seagate 20, 30, 40 and 60MB Half Height Hard Disk Drives

ST225XT Pictured

ST225	20MB Drive only (PC/XT/AT)	**$224.95**
ST225XT	20MB w/Controller (PC/XT)	**$269.95**
ST225AT	20MB w/Controller (AT)	**$339.95**
ST238	30MB Drive only (PC/XT/AT)	**$249.95**
ST238XT	30MB w/Controller (PC/XT)	**$299.95**
ST238AT	30MB w/Controller (AT)	**$389.95**
ST251	40MB Drive only (PC/XT/AT)	**$429.95**
ST251XT	40MB w/Cont. Card (PC/XT)	**$469.95**
ST251AT	40MB w/Controller Card (AT)	**$539.95**
ST251-1	40MB Fast 28ms (Drive only)	**$499.95**
ST277	60MB Drive only (PC/XT/AT)	**$499.95**
ST277XT	60MB w/Controller (PC/XT)	**$549.95**
ST277AT	60MB w/Controller Card (AT)	**$639.95**

30MB Hard Disk Card for IBM PC/XT/AT

- 32.5MB formatted capacity
- Saves space and reduces power consumption
- Easy installation
- Pre-tested and low-level formatted

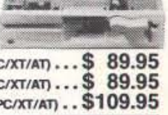
SA30 ~~$399.95~~ **$379.95**

40MB Tape Back-Up for IBM PC/XT/AT

- Allows unattended back-up of 40MB in 40 minutes
- Standard QIC data format
- Easy to use menu-driven software
- Full, incremental, selected, modified or dated file back-up
- Includes one 40MB Tape Cartridge (mfr. may vary)

DJ10	40MB Tape Back-Up and Tape	**$349.95**
TB40	40MB Tape Cartridge	**$24.95**

Jameco 5.25" PC/XT & AT Compatible Disk Drives


JE1022 (Pictured)

JE1020	360K Black Bzl. (PC/XT/AT)	**$ 89.95**
JE1021	360K Beige Bzl. (PC/XT/AT)	**$ 89.95**
JE1022	1.2MB Beige Bzl. (PC/XT/AT)	**$109.95**

2400/1200/300 Modems

Datatronics

- Hayes command compatible
- Bell 103/212A compatible
- Auto-dial/auto-answer
- FCC approved 1-year warranty
- Includes MaxiMite Communication Software (except 1200P)

1200P	1200/300 Baud Pocket Modem	**$ 99.95**
1200H	1200/300 Baud Internal Modem	**$ 69.95**
2400S	2400/1200/300 Internal Modem	**$129.95**
1200C	1200/300 Baud External Modem	**$ 99.95**
2400E	2400/1200/300 External Modem	**$169.95**

PARTIAL LISTING · OVER 4000 COMPONENTS AND ACCESSORIES IN STOCK! · CALL FOR QUANTITY DISCOUNTS

*RAM'S SUBJECT TO FREQUENT PRICE CHANGES

Circle 116 on Reader Service Card

Now available...Jameco's NEW 1989 Catalog with 74 pages of Computer Peripherals, Components & More!

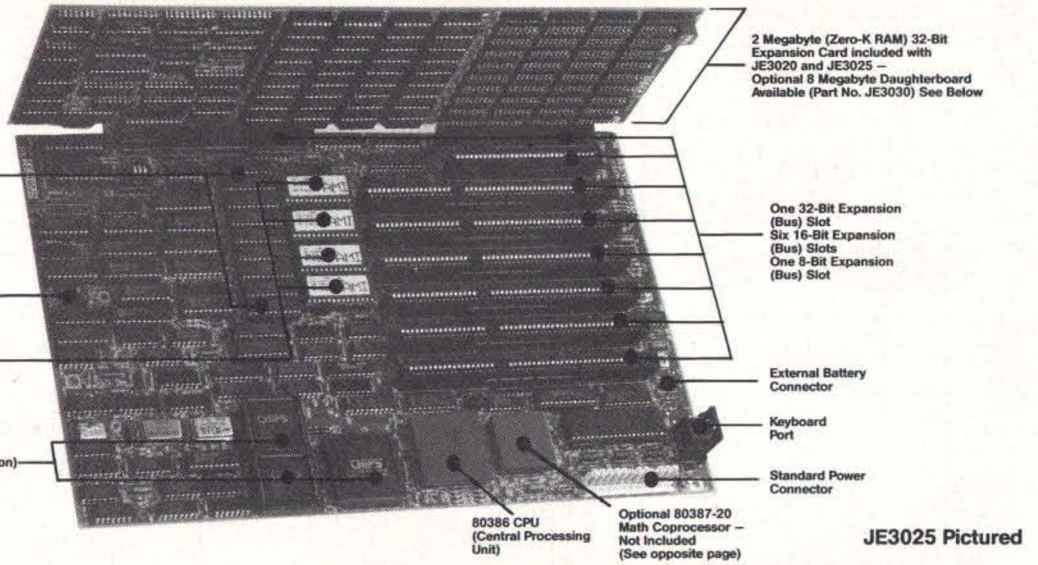
MEMBER MMC MICROCOMPUTER MARKETING COUNCIL of the Direct Marketing Association, Inc

NEW!

AMI 80386 MOTHERBOARDS

NEW!

One-Year Warranty!

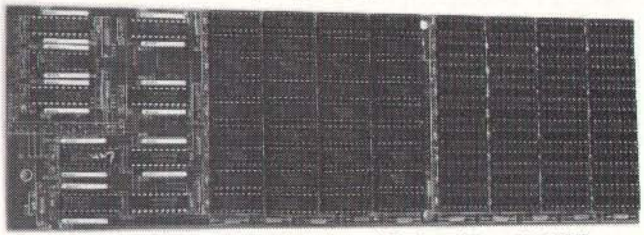

2 Megabyte (Zero-K RAM) 32-Bit Expansion Card included with JE3020 and JE3025 – Optional 8 Megabyte Daughterboard Available (Part No. JE3030) See Below
64K High Speed RAM Cache
One 32-Bit Expansion (Bus) Slot
Six 16-Bit Expansion (Bus) Slots
One 8-Bit Expansion (Bus) Slot
Speaker Output Keyboard Lock and Front Panel LED Connections
Advanced AMI BIOS ROMs (AT Compatible)
External Battery Connector
Keyboard Port
State-of-the-Art VLSI Circuitry (Very Large Scale Integration)
Standard Power Connector
80386 CPU (Central Processing Unit)
Optional 80387-20 Math Coprocessor – Not Included (See opposite page)

JE3025 Pictured

Expandable to 10 Meg!

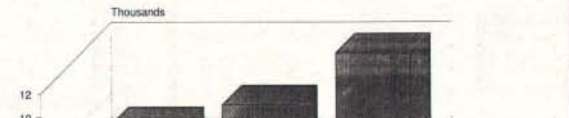
80386 Power and AT Compatibility in an XT Footprint!

The AMI 80386 motherboards are available in either 16MHz or 20MHz versions. The AMI 80386 motherboards fit into an XT, AT or Baby AT chassis so that the board delivers 386 power/performance and AT compatibility in an XT footprint size. The motherboards are ideally suited for a variety of applications including Multiuser (Unix, Xenix, PC MOS), Networking (Novell, 3-Com), CAD applications (Autocad) and Multitasking (Windows, OS/2, Desqview). The board features one 8-bit slot, six 16-bit slots and one 32-bit slot as well as 80387-20 math co-processor capability for the JE3025 and 80387-16 for the JE3020. Both motherboards are keyboard switchable between low and high speed and 1 or 0 wait states. The 20MHz board features a Norton SI rating of 24.2 in the 20MHz mode, while the 16MHz board features a Norton SI rating of 18.7 in the 16MHz mode. AMI BIOS ROMs are included. RAM is mounted on a 32-bit expansion card (included) which utilizes (72) 41256-100 (JE3025) 256K chips to reach 2 Megabytes (the JE3020 utilizes 41256-120 chips). A daughterboard is available (Part No. JE3030) which accepts (72) 511000P-10 1Meg chips for an additional 8 Megabytes, bringing the total memory of the system to 10 Megabytes. BIOS options include built-in set-up and diagnostics. Special features include 64K of high speed static cache RAM on the motherboard and the AMI EGA BIOS which allows for incredibly fast EGA performance when shadowed. • Size: 8.5" x 13" • Weight: 4 lbs. • One-Year Warranty



JE3030 – 8 Megabyte Daughterboard Option (Zero-K RAM)

RELATIVE PERFORMANCE



*See opposite page

Part No.	Description	Price
JE3020	16MHz 80386 AT Compatible Motherboard (Zero-K RAM)	**$1399.95**
JE3025	20MHz 80386 AT Compatible Motherboard (Zero-K RAM)	**$1699.95**
JE3030	8 Megabyte Daughterboard for JE3020 and JE3025 (Zero-K RAM)	**$299.95**

The following names are registered trademarks of their respective companies: Unix is AT&T, Xenix and Windows are Microsoft Corp., PC MOS is The Software Link Inc., Novell is Novell Inc., 3-Com is 3-Com Inc., Autocad is Autodesk Inc., OS/2 is IBM, Desqview is Quarterdeck Information Systems

See opposite page for RAM and Math Coprocessors

U.S. Funds Only
Shipping: Add 5% plus $1.50 Insurance
(May vary according to weight)

California Residents: Add 6%, 6½% or 7% Sales Tax

©1988 Jameco Electronics 11/88

$20 Minimum Order

IBM is a registered trademark of International Business Machines

MasterCard

Mail Order Electronics • Worldwide
Jameco® ELECTRONICS

VISA®

Data Sheets – 50¢ each
Prices Subject to Change

Send $2.00 Postage for a FREE 1989 CATALOG

FAX Numbers: 415-592-2503 or 415-595-2664

Telex: 176043

1355 Shoreway Rd., Belmont, CA 94002 • *24 HR. ORDER HOTLINE 415-592-8097* • Customer Service (7am-5pm PST) 415-592-8121

Circle 116 on Reader Service Card

Circle 76 on Reader Service Card

3M *FREE! Headcleaning Kit

DS-DD	Quantity Discounts Available	DS-HD
.69	5.25" 3M Diskettes	1.45
1.49	3.50" 3M Diskettes	4.45
1.99	8.00" 3M Diskettes	2.25
.85	3M Mark Q PC "Formatted" Disks	
.47	3M Highland Box Diskettes	
.52	3M No Logo Bulk, w/tyvek, labels w/p	

DC-1000 ...... 12.65 DC-300XLP 19.45
DC-2000 ...... 17.05 DC-600A 21.45
3M Mag. Tapes 2400' W-T-S 12.50
3M Mag. Tapes 1200' W-T-S 9.25
14.95 Data Defender 050 For 50 - 3½" Data Defender 070 for 70 - 5¼" w/keys 14.95

BASF *FREE Plastic Library Box

DS-DD	Quantity Discounts Available	DS-HD
.59*	5.25" BASF Diskettes	.89
1.29	3.50" BASF Diskettes	4.45
1.79	8.00" BASF Diskettes	1.99

COLOR-CODED MODULAR FILING CASE/78 FOR $5.95 EA. WITH EACH PURCHASE OF 60.

BASF 5.25" DS/DD Diskettes!
BASF Mag. Tapes 2400' W-T-S 11.95
BASF Mag. Tapes 1200' W-T-S 7.99
BASF No-Logo 5.25" DS/DD .... .42

	MD2-DMP 5.25" DS/DD	MD2-HDMP 5.25" DS/HD	MF2-DDM 3.50" DS/DD
maxell *IN PLASTIC BOX	.72*	1.49*	1.59

	5.25" DS/DD	5.25" DS/HD	3.50" DS/DD
Verbatim DataLife *FREE DataLifePlus Offer Inside	.72*	1.30*	1.49

COLOR DISKS	5.25" DS/DD	3.50" DS/DD	3.50" DS/HD
KAO COLOR DISKS from the Surface Scientists *IN PLASTIC BOX	.72*	1.59*	3.49 2MB

	5.25" DS/DD	5.25" DS/HD	3.50" DS/DD
FUJI	.72	1.49	1.59

Nashua CALL FOR BEST PRICES!

BULK Box of TEN 5.25" DS/DD with sleeves, labels and w/p tabs 3.35

Black Disks		Color Disks
.29	5.25" DS/HD/48 TPI	.39
.69	5.25" DS/HD "AT"	.79
1.09	3.50" DS/HD/135 TPI	1.19

FREE SLEEVES, LABELS AND W/P TABS

RIBBONS STORAGE

—Please call for information—

TERMS: VISA, Mastercard or AMEX. COD only add $3.00. Prepaid orders deduct 2% cash discount. PO's accepted from recognized institutions and corporations on Net 30. Bank draft, T/T or L/C acceptable. **Shipping:** $4/100 or fewer disks. Reduced shipping charges on larger quantities. Price quoted for case (100 disks) quantities less than a case add 5%.

WE BEAT ANY PRICE!

Toll Free Order Line: 1-800-523-9681
Information Line: 1-801-255-0080
TLX-9102404712
FAX-801-572-3327

DISKCOTECH
DISKCO TECHNOLOGIES, INC.
213 Cottage Avenue
P.O. Box 1339 Sandy, Utah 84091

Bullet Modem

- Turbo 2400 bps + MNP™ Class 5
  Up to 7200 bps ....internal $295
  ....external $395
- Up to 19,200 bps $1,195
- 100% Error Free Data
- PSTN & Leased Lines, AT Command

E·T·E·C·H
E-Tech Research
3333 Bowers Avenue, # 165
Santa Clara, CA 95054
(408) 982-0270, FAX (408) 982-0272
Leader in High Performance Modems

Circle 81 on Reader Service Card

Dynamic Electronics
23552 Commerce Center Dr.
Suite L
Laguna Hills
CA 92653

Stocking Distributor of Semiconductors
8087 • 5 • 8 • 10
80287 • 6 • 8 • 10 MEG
80387 • 16 • 20 MEG
256K • 64K • 128K • V20 • V30
Fast• Reliable • Everytime

Phone: 714-855-0411
Fax: 714-855-8504
No refund - exchange only - Exchange good for 30 days unless manufacturer warranties merchandise longer.

Circle 80 on Reader Service Card

EPROM PROGRAMMER
$ 3 4 9

THE EP-1'S A GREAT VALUE AND HERE's WHY:
- READS, PROGRAMS, COPIES OVER 350 EPROM AND EEPROMS FROM 30 MFG'S INCLUDING 2716-27513,2804-28256,27011
- READS/ WRITES INTEL, MOTOROLA, STRAIGHT HEX & BINARY
- OPTIONAL HEADS PROGRAM INTEL 874X,8751,87C51,8755
- MENU-DRIVEN CHIP SELECTION BY MFG & P/N;NO MODULES
- FAST, SLOW, QUICK PULSE PROGRAMMING ALGORITHMS
- SPLITS FILES BY BASE ADDRESS AND ODD/EVEN (16 & 32 BIT)
- ALL INTELLIGENCE IN UNIT; Z80 MICROPROCESSOR BASED
- 5, 12.5, 21,25 V PROGRAMMING FOR CMOS & -A SUFFIX PARTS
- FREE PC-DOS SOFTWARE
- GOLD TEXTOOL ZIF SOCKET
- MONEY BACK GUARANTEE
- 2 FREE FIRMWARE UPDATES
- CHECKSUMS SUPPORTED
- RS232 TO ANY COMPUTER
- 8 BAUD RARES TO 38,400
- ONE YEAR WARRANTY
- SAME DAY SHIPMENT
- UV ERASERS FROM $34.95

CALL TODAY FOR MORE INFORMATION
800/225-2102

BP MICROSYSTEMS
10681 HADDINGTON #190, HOUSTON, TX 77043
713/461-9430 TLX: 1561477 FAX: 713/461-7413

Circle 38 on Reader Service Card

ANALOG I/O and DSP
ideal for PC based Measurement/Test, Control, Acoustics, and Signal Processing

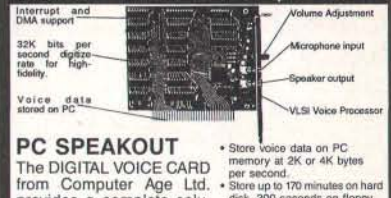
PC-12	•16 SE or 8 DF inputs, programmable gain amplifier, precision S/H, 12-bit A/D, dual 12-bit D/A, I/O Filters, 8-bit digital I/O, memory mapped I/O assisted by timer. $650.
PC-12SC	•12-bit A/D & D/A with I/O Filters and timer, for voice I/O, IEEE Speech Course, etc. $450.
PC-DMA12	•12-bit A/D and D/A to 100 KHz, dual-channel DMA controller for concurrent I/O capability, programmable H/W timer for zero timing jitter, I/O filters, programmable gain and offset amplifier, 16-channel auto-scan multiplexer, 8-bit digital I/O, etc. $1250.
PC-DMA 16	•Features compatible to PC-DMA, but with 16-bit A/D and dual 16-bit D/A. $1595.
PC-DSP 22	•22-bit floating point DSP board for PC, compatible to the above PC-DMA boards for R/T DSP, 1 K complex FFT in 10msec.
SAMPLE EDITOR	•S/W for PC-DMA performs continuous hard disk transfer, search, audio edit, etc.

Other new products include 1 MHz 12-bit A/D and D/A,servo motor controller, etc. All products supported by S/W driver and application packages.

CANETICS, Inc.
PO Box 70549, Pasadena, CA 91107
(818) 584-0438

Circle 40 on Reader Service Card

DIGITAL VOICE CARD (DVC)
for IBM PC, XT, AT and compatibles



PC SPEAKOUT
The DIGITAL VOICE CARD from Computer Age Ltd. provides a complete solution for your voice message management.

DIGITAL VOICE CARD (DVC)	$95.00
MICROPHONE (MIC)	$12.00
3" SPEAKER (SPK)	$9.00

Standalone Digital Voice Recorder (DVR) $89.00 We accept Visa, MasterCard, COD cash. To Order Call Toll-free U.S.

1-800-263-7487

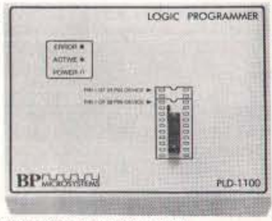
Computer Age Ltd.
P.O. Box 730
Nobleton, Ontario, L0G 1N0
1 (416) 859-0370

- Store voice data on PC memory at 2K or 4K bytes per second.
- Store up to 170 minutes on hard disk, 300 seconds on floppy.
- Digitize voice at 32K bits per second, 10 bits AD/DA.
- Interrupt and DMA support allows concurrent operation with your normal programs.
- Include software drivers for BASIC, C, PASCAL, and DBASE.
- Include Record and Play Demo, Message Reminder programs. Ready to use.

APPLICATIONS YOU CAN USE:
- Voice alarm and reminder for busy executives.
- Telephone message store and forward.
- Send your voice mails on a floppy or through a modem.
- Speech analysis and voice synthesis.
- Voice message management in store, factory, office and hospital.
- Computerized security and monitoring system.
- Sales, exhibit presentation.

Circle 51 on Reader Service Card

UNIVERSAL LOGIC PROGRAMMER



- PROGRAMS, READS, DUPLICATES, TESTS AND SECURES HUNDREDS OF 20- AND 24-PIN DEVICES
- 23 UNIVERSAL PIN DRIVERS WITH INDEPENDENT DAC, ADC & SLEW FUNCTIONS PROGRAM ALMOST ANY LOGIC DEVICE
- MENU DRIVEN OPERATION IS EASY TO LEARN AND QUICK TO OPERATE
- CONNECTS TO ANY IBM COMPATIBLE COMPUTER VIA PARALLEL PRINTER PORT
- EDITS FUSE DATA & TEST VECTORS WITH FULL SCREEN EDITOR
- TESTS WITH VECTORS & SECURES AFTER PROGRAMMING
- SUPPORTS ALL POPULAR PLD DEVELOPEMENT SOFTWARE
- GOLD TEXTOOL ZIF IC SOCKET
- MONEY BACK GUARANTEE
- TOLL-FREE TECH SUPPORT
- UPDATABLE VIA FLOPPY
- EPROM PROGRAMMERS ALSO
- ONLINE HELP FUNCTION
- SELF CALIBRATING
- JEDEC FILE IN/OUTPUT
- ONE YEAR WARRANTY
- SAME DAY SHIPMENT
- JUST $798

CALL FOR FREE DEMO DISK 800/225-2102

BP MICROSYSTEMS
10681 HADDINGTON #190 HOUSTON, TX 77043
713/461-9430 TLX: 1561477 FAX: 713/461-7413

Circle 38 on Reader Service Card

BYTE LISTINGS YOUR WAY!

It's easy. Now there are three ways to get source-code listings that go with BYTE articles—on disk, in print or on line.

LISTINGS ON DISK

BYTE listings on disk are right for you if you want to compile or run programs quickly. Also included on disk are the month's BIX highlights specific to your machine format.

LISTINGS IN PRINT

This print supplement contains source-code listings described in the issues of BYTE.

LISTINGS FROM BIX

(BYTE Information Exchange) By joining BIX, you can download BYTE source-code listings at standard BIX rates. See BIX informational ad listed in Reader Service index in this issue.

☎

FOR DIRECT ORDERING CALL TOLL FREE: 800-258-5485

Call: M–F, 8:30 a.m. to 4:30 p.m. Eastern Time

(603-924-9281 for New Hampshire residents)

For credit card orders only.

ON DISK-

*** Including the Month's BIX Highlights Specific To Your Machine Format.**

Disks of listings from December 1985 to present are available at the prices stated at right. Please mark the appropriate format and note the issue date below. If you are ordering a subscription, please note the issue date on which you would like it to begin.

Month ____________

Year ____________

	IN USA:		OUTSIDE USA:	
	Single Month (one disk)	Annual Subscription (13 disks)	Single Month (one disk)	Annual Subscription (13 disks)
5¼ inch: ☐ IBM PC* ☐ Apple II ☐ Kaypro 2 CP/M ☐ MS-DOS 8 Sector* ☐ TI Professional	☐ $8.95	☐ $69.95 (Save $46.40)	☐ $10.95	☐ $89.95 (Save $52.40)
3½ inch: ☐ Apple Macintosh* ☐ Atari ST* ☐ Amiga* ☐ IBM PS/2*	☐ $9.95	☐ $79.95 (Save $49.40)	☐ $11.95	☐ $99.95 (Save $55.40)

IN PRINT

1988 Supplement Issues

☐ January through March $6.95 in USA $7.95 outside USA

Monthly supplements replace quarterly supplements starting in April. Indicate the month you're ordering in the space below.

Month ____________

Year ____________

$2.50 per issue in USA
$3.50 per issue outside USA

Annual Subscriptions:
$19.00 in USA
$22.00 outside USA

Please note month and year you would like the subscription to begin.

Month ____________

Year ____________

1987 Supplement Issues

IN USA:

☐ January through March 1987 for only $6.95.

☐ April through June 1987 for only $6.95. (Includes 1986 Index).

☐ July through September 1987 for only $6.95.

☐ October through December 1987 for only $6.95.

☐ 1987 subscription only $18.00.

OUTSIDE USA:

☐ January through March 1987 for only $7.95.

☐ April through June 1987 for only $7.95.

☐ July through September 1987 for only $7.95.

☐ October through December 1987 for only $7.95.

☐ 1987 subscription only $21.00.

1986 Supplement Issues

IN USA:

☐ January through June 1986 for only $8.95.

☐ July through September 1986 for only $6.95.

☐ October through December 1986 for only $6.95.

☐ 1986 Annual Subscription for only $18.00.

OUTSIDE USA:

☐ January through June for only $9.95.

☐ June through September for only $7.95.

☐ October through December for only $7.95.

☐ 1986 Annual Subscription for only $21.00.

FOLD HERE

COMBINED DISK AND PRINT SUBSCRIPTION

Bundled together, giving you the convenience of disk-based source-code plus the ease of reference of print.

If you are ordering a subscription, please note the issue date on which you would like it to begin.

	IN USA: Annual Subscription	OUTSIDE USA: Annual Subscription
5¼ inch: ☐ IBM PC ☐ Apple II ☐ Kaypro 2 CP/M ☐ MS-DOS 8 Sector ☐ TI Professional	☐ $89.95 (Save $58.35)	☐ $109.95 (Save $75.35)
3½ inch: ☐ Apple Macintosh ☐ Atari ST ☐ Amiga ☐ IBM PS/2	☐ $99.95 (Save $61.35)	☐ $119.95 (Save $78.35)

FOL HER

Please complete in full.

IBM

Name ____________

Address ____________

City ____________ State ________ Zip ________

County or Parish ____________ Country ____________

Credit Card # ____________

Exp. Date ______ Signature ____________ Date ________

☐ Check enclosed
☐ MasterCard
☐ VISA
☐ U.S. Funds enclosed (If ordering from outside the U.S. please remit in U.S. funds drawn on a U.S. bank. Thank you.)

Please allow 4-8 weeks for delivery.

BYTE

FOLD
HERE

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 10 PETERBOROUGH, NH

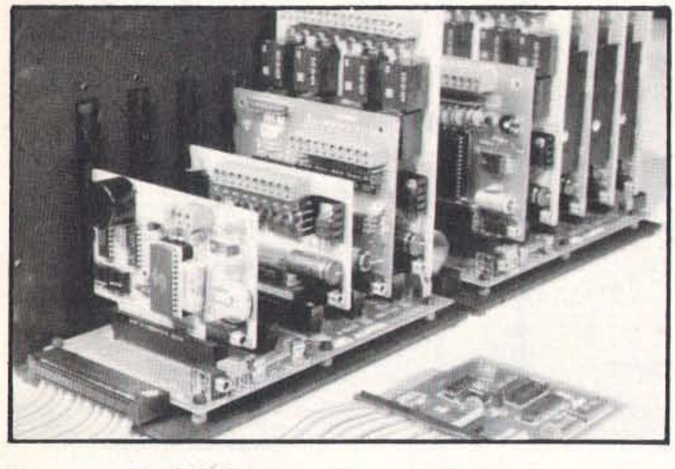
POSTAGE WILL BE PAID BY ADDRESSEE

BYTE Listings
One Phoenix Mill Lane
Peterborough, NH 03458-9990

FOLD
HERE

The Amazing A-BUS

NEW



An A-BUS system with two Motherboards
A-BUS adapter (IBM) in foreground

Plug into the future

With the A-BUS you can plug your PC (IBM, Apple, TRS-80) into a future of exciting new applications in the fields of control, monitoring, automation, sensing, robotics, etc.

Alpha's modular A-BUS offers a proven method to build your "custom" system today. Tomorrow, when you are ready to take another step, you will be able to add more functions. This is ideal for first time experimenting and teaching.

A-BUS control can be entirely done in simple BASIC or Pascal, and no knowledge of electronics is required!

An A-BUS system consists of the A-BUS adapter plugged into your computer and a cable to connect the Adapter to 1 or 2 A-BUS cards. The same cable will also fit an A-BUS Motherboard for expansion up to 25 cards in any combination.

The A-BUS is backed by Alpha's continuing support (our 11th year, 50000 customers in over 60 countries).

The complete set of A-BUS User's Manuals is available for $10.

About the A-BUS:

- All the A-BUS cards are very easy to use with any language that can read or write to a Port or Memory. In BASIC, use INP and OUT (or PEEK and POKE with Apples and Tandy Color Computers)
- They are all compatible with each other. You can mix and match up to 25 cards to fit your application. Card addresses are easily set with jumpers.
- A-BUS cards are shipped with power supplies (except PD-123) and detailed manuals (including schematics and programming examples).

Relay Card **RE-140: $129**

Includes eight industrial relays, (3 amp contacts, SPST) individually controlled and latched. 8 LED's show status. Easy to use (OUT or POKE in BASIC). Card address is jumper selectable.

Reed Relay Card **RE-156: $99**

Same features as above, but uses 8 Reed Relays to switch low level signals (20mA max). Use as a channel selector, solid state relay driver, etc.

Analog Input Card **AD-142: $129**

Eight analog inputs. 0 to +5V range can be expanded to 100V by adding a resistor. 8 bit resolution (20mV). Conversion time 120us. Perfect to measure voltage, temperature, light levels, pressure, etc. Very easy to use.

12 Bit A/D Converter **AN-146: $139**

This analog to digital converter is accurate to .025%. Input range is −4V to +4V. Resolution: 1 millivolt. The on board amplifier boosts signals up to 50 times to read microvolts. Conversion time is 130ms. Ideal for thermocouple, strain gauge, etc. 1 channel. (Expand to 8 channels using the RE-156 card).

Digital Input Card **IN-141: $59**

The eight inputs are optically isolated, so it's safe and easy to connect any "on/off" devices, such as switches, thermostats, alarm loops, etc. to your computer. To read the eight inputs, simply use BASIC INP (or PEEK).

24 Line TTL I/O **DG-148: $65**

Connect 24 input or output signals (switches or any TTL device) to your computer. The card can be set for: input, latched output, strobed output, strobed input, and/or bidirectional strobed I/O. Uses the 8255A chip.

Clock with Alarm **CL-144: $89**

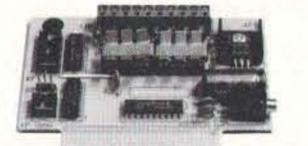
Powerful clock/calendar with: battery backup for Time, Date and Alarm setting (time and date); built in alarm relay, led and buzzer; timing to 1/100 second. Easy to use decimal format. Lithium battery included.

Touch Tone® Decoder **PH-145: $79**

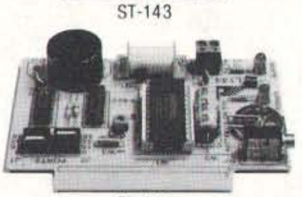
Each tone is converted into a number which is stored on the board. Simply read the number with INP or POKE. Use for remote control projects, etc.

A-BUS Prototyping Card **PR-152: $15**

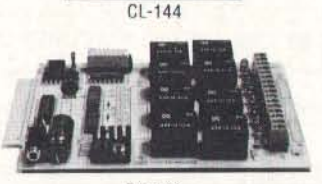
3½ by 4½ in. with power and ground bus. Fits up to 10 I.C.s



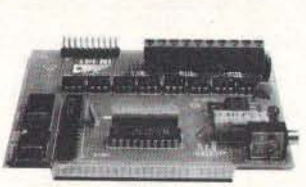
ST-143



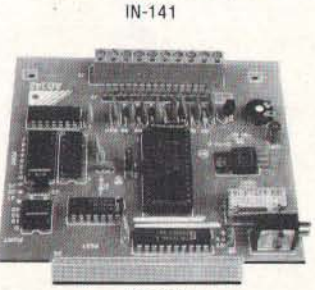
CL-144



RE-140



IN-141



AD-142

Smart Stepper Controller **SC-149: $299**

World's finest stepper controller. On board microprocessor controls 4 motors simultaneously. Incredibly, it accepts plain English commands like "Move arm 10.2 inches left". Many complex sequences can be defined as "macros" and stored in the on board memory. For each axis, you can control: coordinate (relative or absolute), ramping, speed, step type (half, full, wave), scale factor, units, holding power, etc. Many inputs: 8 limit & "wait until" switches, panic button, etc. On the fly reporting of position, speed, etc. On board drivers (350mA) for small steppers (MO-103). Send for SC-149 flyer.

Remote Control Keypad Option RC-121: $49
To control the 4 motors directly, and "teach" sequences of motions.

Power Driver Board Option PD-123: $89
Boost controller drive to 5 amps per phase. For two motors (eight drivers).

Breakout Board Option BB-122: $19
For easy connection of 2 motors. 3 ft. cable ends with screw terminal board.

Stepper Motor Driver **ST-143: $79**

Stepper motors are the ultimate in motion control. The special package (below) includes everything you need to get familiar with them. Each card drives two stepper motors (12V, bidirectional, 4 phase, 350mA per phase).

Special Package: 2 motors (MO-103) + ST-143: **PA-181: $99**

Stepper Motors **MO-103: $15 or 4 for $39**

Pancake type, 2¼" dia, ¼" shaft, 7.5°/step, 4 phase bidirectional, 300 step/sec, 12V, 36 ohm, bipolar, 5 oz-in torque, same as Airpax K82701-P2.

Current Developments

Intelligent Voice Synthesizer, 14 Bit Analog to Digital converter, 4 Channel Digital to Analog converter, Counter Timer, Voice Recognition.

A-BUS Adapters for:

IBM PC, XT, AT and compatibles. Uses one short slot.	AR-133...$69
Tandy 1000, 1000 EX & SX, 1200, 3000. Uses one short slot.	AR-133...$69
Apple II, II+, IIe. Uses any slot.	AR-134...$49
TRS-80 Model 102, 200 Plugs into 40 pin "system bus"	AR-136...$69
Model 100. Uses 40 pin socket. (Socket is duplicated on adapter).	AR-135...$69
TRS-80 Mod 3,4,4D. Fits 50 pin bus. (With hard disk, use Y-cable)	AR-132...$49
TRS-80 Model 4P. Includes extra cable. (50 pin bus is recessed).	AR-137...$62
TRS-80 Model I. Plugs into 40 pin I/O bus on KB or E/I.	AR-131...$39
Color Computers (Tandy). Fits ROM slot. Multipak, or Y-cable.	AR-138...$49

A-BUS Cable (3 ft, 50 cond.) **CA-163: $24**

Connects the A-BUS adapter to one A-BUS card or to first Motherboard.

Special cable for two A-BUS cards: CA-162: $34

A-BUS Motherboard **MB-120: $99**

Each Motherboard holds five A-BUS cards. A sixth connector allows a second Motherboard to be added to the first (with connecting cable CA-161: $12). Up to five Motherboards can be joined this way to a single A-BUS adapter. Sturdy aluminum frame and card guides included.

Add $3.00 per order for shipping.
Visa, MC, checks, M.O. welcome.
CT & NY residents add sales tax.
C.O.D. add $3.00 extra.
Canada: shipping is $5
Overseas add 10%

ALPHA Products
a Sigma Industries Company
242-B West Avenue, Darien, CT 06820

Technical info: **(203) 656-1806**
Orders only Except in CT **800 221-0916**
Connecticut orders: **(203) 348-9436**
All lines open weekdays 9 to 5 Eastern time

Circle 6 on Reader Service Card

ON TARGET ASSOCIATES

Products and Services
for Design and Manufacturing Engineers.

PS/2
- Micro Channel Design Consulting
- Prototype Cards
- Newsletter
- ASIC's
- Extender Cards
- Adapter Bracket Sets
- Burn-in Mother Boards

We will move your PC/XT/AT products to the Micro Channel, or create your new design.

CALL: (408) 980-7118
for our Free catalog

ON TARGET
TARGET
TARGET

...the PS/2 leaders.

PS/2 and Micro Channel are trademarks of IBM Corp.

Circle 160 on Reader Service Card

Get the whole story on graphics terminal emulation.

To find out more about software that lets your PC emulate TEKTRONIX™ 4105/6/7/9 and DEC VT100™ terminals, call or write:

GRAFPOINT

4340 Stevens Creeks Blvd., Suite 280,
San Jose, CA 95129 (408) 249-7951

Circle 98 on Reader Service Card

DATA ACQUISITION PROCESSOR™

- onboard intelligence for IBM PC/XT/AT
- analog and digital I/O to 150,000 samples/second
- 80186 coprocessor — real time processing
- onboard software, incl. FFT
- run applications without programming
- direct access to Lotus 1-2-3
- manual with tutorial and sample applications — $20
- digital I/O from $995
- analog I/O from $1595

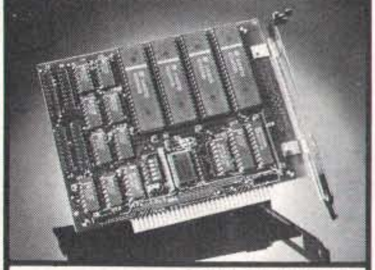
MICROSTAR LABORATORIES

(206) 881-4286
2863 152 Ave. N.E.
Redmond, WA 98052
Telex 510 601 3473

Circle 143 on Reader Service Card

COMM + 4

- Four Serial Ports
- RS-232C Or RS-422/485
- DB-25 Or DB-9 Connectors
- Interrupt & DOS Software
- Delivery From Stock



SEALEVEL

SEALEVEL SYSTEMS INC.
PO BOX 1808
EASLEY, SC 29641
(803) 855-1581

Circle 198 on Reader Service Card

DYNAMIC RAMS

	1MBIT	100ns	$38.00
	514256	100ns	$49.00
	41464	150ns	$12.50
	41256	100ns	$12.95
	41256	120ns	$12.15
✓	41256	150ns	$10.85
	51258	100ns	$12.25
✓	4164	150ns	$ 2.95

* For high-speed, Zip, Plcc, Simm ...... Please Call !

PROCESSORS

80387-16	16mHz	$419.00
80287-10	10mHz	$265.00
80287-8	8mHz	$225.00
80287-6	6mHz	$159.00
8087-1	10mHz	$205.00
8087-2	8mHz	$142.00
8087	5mHz	$ 99.00
V-30	8mHz	$ 12.75
V-20	10mHz	$ 17.00
V-20	8mHz	$ 8.50

E PROMS

27C101	250ns	$ 24.00
27C512	200ns	$ 15.00
27512	250ns	$ 12.95
27C256	250ns	$ 5.50
27256	250ns	$ 4.95
27128A	250ns	$ 5.25
27C64A	200ns	$ 4.95
2764	250ns	$ 3.50

S. RAMS

43256	120ns	$ 16.95
4364	150ns	$ 13.50

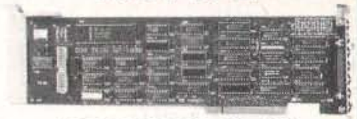
I.C. EXPRESS

15358 Valley Blvd. City of Industry, CA 91746 Tel:818-369-2688
ORDER TOLL FREE (Mon-Fri 8-5 PST)
(800) 892-8889 · (800) 882-8181
outside california — inside california
CALL FOR CURRENT PRICES & VOLUME DISCOUNTS.
Price Shown for cash. MasterCard/Visa add 3%. Prices are subject to change.
Minimum order $10.00. Shipping & Handling: UPS Ground $5.00, Air $7.00 (1 lb.)
ALL MERCHANDISE IS 100% GUARANTEED WITH PROMPT DELIVERY.

Circle 110 on Reader Service Card

NEW

PARALLEL PORT FOR PS/2



MODELS 50, 60, 80

- LPT1, LPT2, LPT3
- Optional Serial Port
- OEM Pricing Available

1-800-553-1170

QUA TECH INCORPORATED

478 E. Exchange St., Akron, OH 44304
TEL: (216) 434-3154 FAX: (216) 434-1409
TLX: 5101012726

Circle 180 on Reader Service Card

BIOS SOURCE CODE

The **XT BiosKit** is a 270 page book with a diskette containing source code in C, plus utility programs to help you create a Bios. Now you can have a Bios with documentation for your own applications: modify boot-up, eliminate the keyboard, install security features, etc. Only $99 complete. The **AT BiosKit** is only $199, or get both Bioskits for $279.

— XT-AT HANDBOOK —

The **XT-AT Handbook** is full of hardware and software information in a shirt pocket size book. Over 70 pages covering 38 subjects, including connectors, I/O maps, controller programming, DOS and DEBUG commands, board dimensions, character codes, hard disk drive types, and much more. Only $9.95 each qty 1-4, five or more, $5 each.

Annabooks
12145 Alta Carmel Ct. 250, Suite 262
San Diego, California 92128
(619) 271-9526

Circle 15 on Reader Service Card

9-Track Tape Drives: Yes! for IBM PC/XT/AT/386 *and* PS/2

Interchange tapes from mainframes.

Important features:
- 800, 1600, 3200, 6250 BPI
- EBCDIC/ASCII conversion
- IBM & ANSI labeled tapes
- Network backup
- DOS, XENIX, Microport
- Highest quality customer service

For quick delivery we stock all major manufacturers' tape drives, including Cipher, Kennedy, M4 Data, Qualstar.

Prices start at $3,755. Call Today!

Overland Data, Inc.
5620 Kearny Mesa Rd. • San Diego, CA 92111
Tel: (619) 571-5555 • FAX: (619) 571-0982

Circle 164 on Reader Service Card

3M 5.25" Diskettes Formatted for IBM PC

Save at least 15 minutes of formatting time per diskette box.
For IBM PC, XT & comp.:
DOS 2.0 & Higher

99¢ ea.

3M 3.5" Micro Diskettes For IBM Personal System/2

1.0 MB **$1.69 ea.**
2.0 MB **$4.99 ea.**

3M Data Cartridges on Sale Now

Free *Fall Catalog; complete line of quality computer supplies. Foreign Inquiries Invited.*

Minimum Order: $50.00. S&H, USA: $4.00/100 disks
Prices Subject to Change.

C.O.D.

Order Toll Free 800-258-0028

Precision Data Products™
P.O. Box 8367, Grand Rapids, MI 49518
MI: 800-632-2468
616-452-3457 **FAX: 616-452-4914**

Circle 173 on Reader Service Card

WIN

WIN WIN

TEN THOUSAND DOLLARS or a NEW JEEP WRANGLER...

American Semiconductor®

Call Today and you could win **Ten Thousand Dollars, a New Jeep Wrangler,** or numerous other great prizes. Now with over 2,500 Service Centers Nationwide!* **Be a winner with American Semiconductor.**

Plus... OVER A **BILLION** IN FINANCING AVAILABLE

NOT A LEASE...YOU OWN IT!

$35.$^{mo.}$

ASI TURBO MODEL #5301

• **100% XT COMPATIBLE** • **4.77 & 8 MHz** Processing Spd, **10 MHz** Oppt, • **0-16 MB RAM** Available • **BIOS** • **8088-1 CPU,** • **150 Watt P/S** • **AT** Enhanced **101 Key** Keyboard • AT Case • One **360K DS/DD Floppy** w/Cont. & Cable, Oppt. **2nd PS/2** Compatible **3.5" Drive** • **8** Expansion Slots • **Operates: MS/DOS, PC DOS, GW BASIC, NOVELL, UNIX.** Retail Value $1,099

OUR PRICE $599

$39.$^{mo.}$

ASI TURBO MODEL #5302

• **100% XT COMPATIBLE** • **4.77 & 8 MHz** Processing Spd, **10 MHz** Oppt. • **0-16 MB RAM** Available • **BIOS** • **8088-1 CPU,** • **150 Watt P/S** • **One 360K DS/DD Floppy** Half Height Floppy Drive & Cable, Oppt. **2nd PS/2** Compatible **3.5" Drive** • **8** Expansion Slots, **Multi I/O** w/Floppy Controller, Clock, Calendar, Serial, Parallel & Game Port, AT Enhanced 101 Key Keyboard, AT Case • **8087** Coprocessor Socket • **Operates: MS/DOS, PC DOS, GW BASIC, NOVELL, UNIX.** Retail Value $1,599

OUR PRICE $688

$45.$^{mo.}$

ASI TURBO MODEL #5303

• **100% XT COMPATIBLE** • **4.77 & 8 MHz** Processing Spd, **10 MHz** Oppt. • **0-16 MB RAM** Available • **BIOS** • **8088-1 CPU,** • **150 Watt P/S** • AT Case • One **360K DS/DD** Half Height Floppy Drive w/Oppt. **2nd PS/2** Compatible **3.5" Drive** • **Multi I/O** w/Floppy Controller, Clock, Calendar, Serial, & Game Port, • **10 MB** Hard Drive w/Dual Controller • AT Enhanced **101** Key Keyboard • **8087** Co-processor Socket • AT Case • **8** Expansion Slots • **Operates: MS/DOS, PC DOS, BASIC, NOVELL, UNIX.** Retail Value $1,989

OUR PRICE $978

$49.$^{mo.}$

ASI TURBO MODEL #5304

• **100% XT COMPATIBLE** • **8 & 10 MHz** Clock Spd, • **0-16 MB RAM** Available • **BIOS** • **8088-1 CPU** • **Two 360K DS/DD** Half Height Floppy Drives, w/Cable, Oppt. 2nd **PS/2** Compatible **3.5" Drive,** • **Multi I/O** w/Controller, Cable, Clock Calendar, Serial & Game Port • One **20 MB** Hard Drive w/Dual Controller • **TURBO**/Normal Mode Either Software or Hardware Selectable • **150 Watt P/S** • **8** Expansion Slots • **AT** Enhanced **101** Key Keyboard • **8087** Coprocessor Socket • **Operates: MS/DOS, PC DOS, GW BASIC, NOVELL, UNIX.** Retail Value $2,499

OUR PRICE $1,171

$55.$^{mo.}$

ASI TURBO MODEL #5305

• **100% XT COMPATIBLE** • **8 & 10 MHz** Clock Speed, • **0-16 MB RAM** Available • **BIOS** • **8088-1 CPU,** • **Two 360K DS/DD** Half Height Floppy Drives w/Oppt. 2nd **PS/2** Compatible **3.5"** Drive • **Multi I/O** w/Floppy Controller, Clock, Calendar, Parallel, Serial & Game Port • **30 MB** Hard Drive, w/Dual Controller • **TURBO**/Normal Mode, Either Hardware or Software Selectable • **AT Case** • **AT** Enhanced **101** Key Keyboard • **8** Expansion Slots • **150 Watt P/S.** • **Operates: MS/DOS, PC DOS, GW BASIC, NOVELL, UNIX.** Retail Value $2,999

OUR PRICE $1,298

$69.$^{mo.}$

ASI TURBO MODEL #5306

• **100% XT COMPATIBLE** • **8 & 10 MHz** Processing Spd, **12 & 16 MHz** Oppt. • **BIOS** • **0-16 MB RAM** Available • **8088-1 CPU,** • Two **360K DS/DD** Half Height Floppy Drives, Oppt. 2nd **PS/2** Compatible **3.5" Drive** • **Multi I/O** w/Floppy Controller, Clock, Calendar, Serial, & Game Port, • **20 MB** Hard Drive w/Dual Controller • TURBO/Normal Mode either Software or Hardware Selectable • **AT 101** Key Keyboard • AT Case • **150 Watt P/S** • **8** Expansion Slots • **8087** Co-processor Socket • **IBM Inc. Compatible Enhanced Graphics Adaptur (EGA)** • **High Resolution EGA Color Monitor.** • **Operates: MS/DOS, PC DOS, GW BASIC, NOVELL, UNIX.** Retail Value $3,899

OUR PRICE $1,799

$55.$^{mo.}$

ASI TURBO MODEL #5501

• **100% AT COMPATIBLE** • **10 MHz** Clock Spd, Oppt. **12 & 16 MHz** • **0-16 MB RAM** Available • **BIOS** • **Intel 80286** Microprocessor • **1.2 MB** Half Height Floppy Drive, Hard Floppy Controller, Serial, Parallel Port and Real Time Clock • **40 MB** Hard Drive w/Dual Controller • **AT** Enhanced **101** Key Keyboard • AT Case • **200 Watt P/S** • **80287** Coprocessor Socket • **8** Expansion Slots • AT OS/2 Interface. Retail Value $5,999

OUR PRICE $1,616

$69.$^{mo.}$

ASI TURBO MODEL #5502

• **100% AT COMPATIBLE** • **10 MHz** Clock Spd, Oppt. **12 & 16 MHz** • **0-16 MB RAM** Available • **BIOS** • **Intel 80286** Microprocessor • **1.2 MB** Half Height Floppy Drive, Hard Floppy Controller, Serial, Parallel Port and Real Time Clock • **20 MB** Hard Drive w/Dual Controller • **AT** Enhanced **101** Key Keyboard • AT Case • **200 Watt P/S** • **80287** Coprocessor Socket • **8** Expansion Slots • AT OS/2 Interface. Retail Value $3,999

OUR PRICE $1,743

$69.$^{mo.}$

ASI TURBO MODEL #5503

• **100% AT COMPATIBLE** • **10 MHz** Clock Spd, Oppt. **12 & 16 MHz** • **0-16 MB RAM** Available • **BIOS** • **Intel 80286** Microprocessor • **1.2 MB** Half Height Floppy Drive, Hard Floppy Controller, Serial, Parallel Port and Real Time Clock • **30 MB** Hard Drive w/Dual Controller • **AT** Enhanced **101** Key Keyboard • AT Case • **200 Watt P/S** • **80287** Coprocessor Socket • **8** Expansion Slots • AT OS/2 Interface. Retail Value $4,499

OUR PRICE $1,849

$79.$^{mo.}$

NEW 386 TOWER MODEL #5702

• **100% AT COMPATIBLE** • **16, 20, 24, & 33 MHz** Processor Spd, • **Intel 80386 Microprocessor** • **32 Bit** Architecture • Compatible with **8 MHz 80286** Hardware or Software • **386 BIOS** • **4 Spd** Selection **(16, 8, 6, & 4.77 MHz)**, Relocation of BIOS • **EGA BIOS to 32 Bit** High Spd RAM for Lighting Fast Execution • Real Time Clock • **4, 8, or 10 MHz 80287** Coprocessor Socket, Or **80387** Coprocessor High Spd Memory Board w/**0-16 MB RAM** Available • Standard **32 Bit RAM** Available, Connectors For Attaching Up to **10 MB** of Memory • **1.2 MB** Half Height Floppy Drive, Oppt **PS/2** Compatible **3.5" Drive** • **8** Expansion Slots • Serial Parallel Adapter • **AT Compatible, OS/2 Compatible** • **Available in AT Case.** Retail Value $9,199

OUR PRICE $2,679

LAP-TOPS $45

From

LAPTOP MODEL #5402

• **80188 COMPATIBLE** • **7.16 MHz** • **ROM 32 KB** Standard • **BIOS** • **RAM 256KB** Standard • Expandable to **640 KB** • **3.5" 720 KB FDD x 1**, Oppt. 2nd **3.5" FDD or 20-40 MB** Hard Disk Drive • Supertwist Crystal Display • Capacity: **80** Characters x **24** lines (**640** x **200** pixels) • **0** degrees-**180** Degrees Tilt Angle Adjustment • **78/88** Key Stop Sculptured Keyboard with Integrated Numeric Keypad • Parallel (Centronics) port x 1 • External **5¼" FDD** unit I/Fx1 Slot for **EPROM** card or **SIQ card x 1** • **12-1/8"** (W) x **3"** (H) x **13-23/24"** (D) • Approx. 10 lbs. • Lead Battery (7 hrs. operation) • **AC** Adapter, **MS/DOS 2.11.**

FROM $955-$2,995

Even if you have a computer...We'll sell you the add-ons from our **TOP QUALITY** products, and **FINANCE** them too!

SURGE PROTECTORS, POWER DISTRIBUTION CENTERS, MONITORS AND RAMS ARE OPTIONAL AND ADDITIONAL.

*Available on AT, and XT Motherboards respectively.

*Available on Extended Care Plan.

master charge VISA American Semiconductor

SAY CHARGE IT!
ADD 3.9% FOR MC/VISA
TO ORDER TOLL FREE CALL 1-800-825-7283
TOLL FREE TECH. LINE 1-800-237-5758
CUSTOMER SERVICE (813) 886-8631
OPEN MON.-FRI. 8am-7pm LATE, LATE, LATE
OPEN SATURDAY 9am-8pm (EST)
CORPORATE OFFICE: 15240 RACE TRACK ROAD, TAMPA, FL 33626

TO ORDER TOLL **FREE** CALL

1-800-825-SAVE
7 2 8 3

Circle 12 on Reader Service Card (DEALERS: 13)

BT 1088

OVER 30,000 CUSTOMERS

XT, AT, ARE REGISTERED TRADEMARKS OF IBM, INC.
PRICES PAYMENTS SUBJECT TO CHANGE WITHOUT NOTICE
VOID WHERE PROHIBITED BY LAW. $25.00 APPLICATION FEE

Circle 75 on Reader Service Card

DiskMASTER®
The Ultimate Diskette Value ...

Discover the Difference ...

2 FOR 1 LIFETIME WARRANTY

COLOR

- ✓ Pkg'd in 6 different colors, bulk or boxed
- ✓ 100% tested and certified
- ✓ Guaranteed clipping level of 65% or above
- ✓ Includes tyvek envelopes (not paper), write protect tabs and user labels
- ✓ Quality at affordable prices

5-1/4" - 48 TPI DS-DD		DS-HD 96 TPI IBM-AT Compatible
.49	BULK COLOR OR GRAY	**.90**
.59	BOXED COLOR	**.99**

CENTECH® America's Premium Quality Color Diskettes

- ✓ TIMELESS WARRANTY
- ✓ 75%+ clipping level guaranteed
- ✓ Each disk 100% tested and certified
- ✓ 18 COLORS for data organization
- ✓ Pkgs. include sleeves, w/p tabs, & ID labels

5-1/4" - 48 TPI DS-DD		DS-HD 96 TPI IBM-AT Compatible
.84	PLASTIC STORAGE BOX COLOR	**1.39**
.63	BULK COLOR	**1.15**
3-1/2" - 135 TPI DS-DD COLOR		**3-1/2" - 135 TPI BLACK DS-HD**
1.75	PLASTIC STORAGE BOX	**4.50**

BASF

5-1/4" 48 TPI DS-DD	DS-HD 96 TPI IBM-AT Compatible
.64	**.94**
3-1/2" DS-HD	3-1/2" DS-DD
4.50	**1.34**

Call for best prices on Data Cartridges & Pelikan Ribbons

5-1/4" - 48 TPI DS-DD	DS-HD 96 TPI IBM-AT Compatible
.72	**1.48**

Nashua

5-1/4"- 48 TPI DS-DD		DS-HD 96 TPI IBM-AT Compatible
.47	BOXED	*** .84***

BULK

32¢ 5-1/4" DS/DD 48 TPI
Exceeds ANSI specifications
+ 6¢ FOR TYVEK

ORDERING INFORMATION

TERMS: P.O. orders accepted, government and schools on net 30. **SHIPPING:** U.S. orders add $3.00 per 100 diskettes or fraction thereof, add $3.00 for COD orders.
PRICE PROMISE: We will better any lower delivered price on the same products and quantities advertised nationally.

☎ MasterCard · American Express · VISA

Toll Free Order Line: **1-800-233-2477**
Information Line: **1-801-561-0092**

DISC INTERNATIONAL
SUPPLY COMPANY
1376 W. 8040 S. / WEST JORDAN, UT 84088
HRS: 8 AM TO 5 PM (MTN. TIME)

SMART SWITCHES

. . . at your command

Master Switch is sophisticated yet flexible. Several computers can access one another or share printers and modems. Use serial or parallel interfaces, up to nine ports. The buffer is expandable up to one megabyte. Access a job control menu from each computer to view the queue or cancel, hold, and release jobs. Many other features.

MasterNet software allows computer networking and electronic mail capabilities for PCs.

Other solutions from ROSE

- Printer Sharing
- Protocol Conversion
- Buffering
- Micro to mainframe
- Multiplexers
- Modems
- Manual Switches
- Cables

We design a variety of quality products for computer networking and data communication solutions guaranteed to work.

Dealer and OEM inquiries are welcome.

ROSE ELECTRONICS P.O. BOX 742571 HOUSTON, TX 77274
CALL FOR CATALOG 713 933 7673

Circle 243 on Reader Service Card (DEALERS: 244)

CHIP SHOP

CALL FOR THE LOWEST PRICES

SAME DAY SHIPMENT

4164	8087
4128	80287
41256	80387

1 meg chips
V20, V30 and more

SABINA INTERNATIONAL, INC.
Phone 1-800-2 SABINA
Phone 1-714-594-6336
FAX 714-595-4008

Circle 193 on Reader Service Card

2400BAUD $95 MODEM

30 DAY FREE TRIAL

WE AREN'T KIDDING...HIGH PERFORMANCE TEXAS INSTRUMENT CHIP SET. LOW COST, NO COMPROMISE 2400, 1200, 300 BAUD MODEM. FULL FEATURED, HAYES COMPATIBLE IBM INTERNAL. SOFTWARE INCLUDED. 30 DAY MONEY BACK TRIAL
CALL FOR DETAILS

CompuCom Corporation
(800) ACT ON IT (408) 732-4500 (CA)

Circle 49 on Reader Service Card

SAVE ON

9 TRACK TAPE SYSTEM

FOR IBM PC/XT/AT

- Mainframe to PC Data Transfer
- High Speed Backup
- All Software, Complete System
- Service and Support, easy Installation

call **(818) 343-6505** or write to:
Contech Computer Corp.
P.O. Box 153 Tarzana, Calif. 91356

CONTECH

Circle 56 on Reader Service Card

Sure it's insured?

SAFEWARE® Insurance provides full replacement of hardware, media and purchased software. As little as $39/yr. covers:
• Fire • Theft • Power Surges
• Earthquake • Water Damage • Auto Accident

For information or immediate coverage call:
1-800-848-3469
In Ohio call 1-614-262-0559

SAFEWARE

SAFEWARE, *The Insurance Agency Inc.*

Circle 194 on Reader Service Card

Statistical Software for OS/2 ?

Of course

General Statistical Analysis

Forecasting and Modeling

Quality Improvement

To find out more contact:

Scientific Computing Associates
Lincoln Center, Suite 106
4513 Lincoln Avenue
Lisle, Illinois 60532
Telephone: 312-960-1698

Circle 196 on Reader Service Card

This could be the most productive phone number you call today. Toll free.

1(800)531-5369

(Or, if you prefer to FAX your order—1 (512) 344-2985.)

TrippLite® Battery Back-Ups

Protect your equipment and data by providing safe shut down time for your computer systems and other sensitive equipment during black or brown-outs. Data loss from one black-out can cost you hundreds, if not thousands of dollars.

These units feature AC line spike and noise suppressors, status indicator lights and heavy gel-cell batteries—a regulated battery charger automatically restores battery to full charge when AC power returns.

This complete TrippLite® Series offers reliable battery back-up at an extremely low price.

Model	Rating	Price
BC-200	200-W	$239.00
BC-325	325-W	$299.00
BC-750	750-W	$599.00
SC-BC-2000	2000-W	$1299.00
BC-1200	1200-W	$799.00
BC-450	450-W	$399.00

OMNI Power Director

$79.95

CC16-P

TrippLites' ISOBAR command console provides the highest level of surge and noise suppression of any console unit on the market today.

Features include 6 outlets, 5 lighted power switches, protection indicator light, 15 amp circuit breaker and 12-foot power cord.

Eprom Programmer

$179.95

EW-904

You can program your own EPROMS with this EPROM programmer—it can program up to 4, 16K thru 512K EPROMS simultaneously—easy to use software is included.

Eprom Eraser

$79.95

LA-6T

You can erase your EPROMS quickly and easily at home or workplace with this easy to use EPROM eraser with built-in timer. It features an adjustable exposure time with alarm and is static protected.

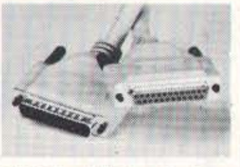
Without timer (not shown). LA-6A **$59.95**

TrippLite® Voltage Regulator—Line Conditioners

Model	Price
LS-600	$79.00
LC-1200	$149.00
LC-1800	$199.00

TrippLite® Line Stabilizer/Conditioners automatically adjust varying input voltage to provide *full voltage support* during a low voltage condition while suppressing spikes and line noise.

Cable Assemblies



PC/AT Parallel Printer Cables

Stock #	Length	Price
PPC301-6	6 ft.	$ 6.95
PPC301-10	10 ft.	7.95
PPC301-15	15 ft.	11.95
PPC301-25	25 ft.	17.95
PPC301-6RA	6 ft.	12.95

DB-25 - 25 Line Cables Male-Male

Stock #	Length	Price
25MM-6	6 ft.	$ 6.95
25MM-10	10 ft.	7.95
25MM-25	25 ft.	17.95
25MM-50	50 ft.	33.95
25MM-100	100 ft.	62.95

POPULAR CABLES

Stock#	Description	Price
MEC-6	Monitor Ext.	$5.95
KEC-6	Keyboard Ext.	3.95
ACPC-03	Power Adapter	4.95
ATM-6	AT Modem Cable	5.95

call Other cables available

DB-25 - 25 Line Cables Male-Female

Stock #	Length	Price
25MF-6	6 ft.	$ 6.95
25MF-10	10 ft.	7.95
25MF-25	25 ft.	17.95
25MF-50	50 ft.	33.95
25MF-100	100 ft.	62.95

Hard Drive Cases

SDH-2H **$99.00**

This sturdy metal cabinet is capable of handling up to two ½ height hard disk drives — comes complete with fan, switching power supply and mounting hardware. (Drive cables not included) 14⅞"W X 13⅞"D X 2⅝"H.

Switchboxes

These sturdy metal switchboxes allow you to share computers, printers and other peripherals quickly and easily. They have gold-plated contacts and are EMI-RFI protected.

DB-25 25 Line Switchboxes

Stock #	Description	Price
AB25-2	Two position	$19.95
AB25-3	Three position	25.95
AB25-4	Four position	28.95
AB25-5	Five position	38.95
AB25-6	Six position	59.95
AB25-X	Cross over	29.95

Centronics 36 Line Switchboxes

Stock #	Description	Price
AB36-2	Two position	$23.95
AB36-3	Three position	29.95
AB36-4	Four position	34.95
AB36-5	Five position	44.95
AB36-X	Cross over	37.95

We carry a complete line of switchboxes for your different requirements. Call for more information!

Altex Electronics, Inc.

"Your Electronics Supply House"

TERMS: Minimum order $10.00. We accept Mastercard, Visa, and American Express at no additional charge. For C.O.D. orders, add $2.20. For orders under $100.00, add $3.00 handling and actual UPS shipping charges. For orders over $100.00, we pay handling charge—you pay actual UPS shipping charges plus insurance. Purchase orders accepted from approved accounts. All returns require an RMA# and are subject to a restocking fee. Texas residents add 7.5% sales tax. Prices subject to change and we are not responsible for typographical errors.

Store Hours: 8:00-6:00 M-F, 10:00-2:00 SAT CST
10731 Gulfdale, San Antonio, Texas 78216

Circle 8 on Reader Service Card

Circle 165 on Reader Service Card (DEALERS: 166)

PACIFIC-286-12

- 80286-12
- 1.2MB Floppy Drive (Option $120 3½" Drive)
- 640K Ram (Option $95 for 360K Drive)
- Serial/Parallel
- 101-Key Enhenced Key Board
- SI = 13.3 (1 Wait)
  SI = 15.2 (O Wait $150 Option)
- 6/12 MHz Key Board Switchable
- WA2 HD & FD Controller

MONO SYSTEM
- W/Mono Monitor
- 20 MB Hard Disk

$1195

CGA COLOR SYSTEM
W/CGA Monitor
20 MB Hard Disk

$1395

EGA COLOR SYSTEM
- W/EGA Card
  W/EGA Monitor
  W/20 MB Hard Disk

$1580

LCD-286 PORTABLE

- 10 MHz 80286
- 640K Ram
- SI = 10.3
- Key Board
- LCD Screen
- Super Twist Back Lighting
- Serial/Parallel
- 1.2 MB Floppy Drive
- 80287 Socket
- 200 W Power Supply
- 20 MB Hard Disk
- 23 lbs.
- Size 15¾" x 9½" x 8"

$1595

LCD-386

- 20 MHz SI = 23
- 80386-16
- One 1.2 MB Floppy Drive
- 40 MB Hard Disk (ST-251)
- LCD Screen (640x200)
- Key Board
- I/O Serial/Parallel

$2795

PACIFIC-386

- 80386-16 (20 MHz)
- SI = 23
- 1 MB Memory
- One 1.2 MB Floppy Drive
- 40 MB (Seagate ST-251)
- 101 Enhanced Key Board
- 200 W Power Supply
- I/O Card Serial/Parallel
- 80387 Socket

MONO SYSTEM
- W/Mono/P Card
- Mono Monitor

$2395

EGA COLOR SYSTEM
- W/EGA Card (640x350)
- EGA Monitor

$2785

CRT-PORTABLE 8088

- Compaq Type
- 8088-1 10 MHz
- 2 Floppy Drive
- 150W Power Supply
- TTL Disply 9" Amber
- Key Board

$770

CRT-PORTABLE-286

- Conpaq Type
- 80286 (10 MHz or 12 MHz)
- One 1.2 MB Floppy Drive
- 200 W Power Supply
- TTL Disply 9" Amber
- At Key Board
- I/O Card Serial/Parallel
- WA2 HD & FD Controller
- 20 MB Hard Disk

$1389

**PRICE SUBJECT TO
CHANGE WITHOUT NOTICE**

**Dealers are welcome
Call For Quantity Price**

PACIFIC COMPUTER (818) 571-5548

120 E. Valley Blvd., #H, San Gabriel, CA 91776
FAX: 818-571-0905
(800) 346-7207 (California)
(800) 421-1102 (Outside California) **ORDER ONLY**

9-Track Tape Subsystem for the IBM PC/XT/AT

Now you can exchange data files between your IBM PC and any mainframe or minicomputer using IBM compatible 1600 or 6250 BPI 9-Track tape. System can also be used for disk backup. Transfer rate is up to 4 magabytes per minute on PCs and compatibles. Subsystems include 7" or 10½" streaming tape drive, tape coupler card and DOS compatible software. For more information, call us today!

QUALSTAR®

9621 Irondale Ave., Chatsworth, CA 91311
Telephone: (818) 882-5822

Circle 181 on Reader Service Card

8051 FAMILY EMULATORS

For info call:

Austria	02 22 38 76 38-0
Australia	02 654 1873
Denmark	02 65 81 11
Finland	See Sweden
France	01 69 412 801
Great Britain	01 464 2586
Israel	03 499034
Korea	02 784 7841
New Zealand	04 886 375
Norway	See Sweden
Portugal	01 83 56 70
Spain	03 217 2340
Switzerland	01 740 41 05
West Germany	08 131 16 87
Sweden	040 92 24 25
U.S.A.	408 866 1820

nohau
CORPORATION

51 E. Campbell Ave., #107E
Campbell, CA 95008
(408) 866-1820

Circle 156 on Reader Service Card

'Cool It...'

...and Enhance Computer Reliability

Only
$5*

The **New Cool Chip** Heat Sink easily attaches to your Processor or Coprocessor for up to **30°** **Cooler Operation** and **Longer Life!**

**8088, 8087, 8086, 80287, V20*	**$5 ppd**
80286, 80386, 80387	**$10 ppd**

(TX res. add 7.5% sales tax. COD add $2.50)

ORDER NOW! or send for Free Info.

SCITECH
CORPORATION

CHECK or COD

P.O. Box 334, Dept. B
Groves, Texas 77619
Phone Orders: (409) 962-3176

Dealer Inquiries Invited

Circle 197 on Reader Service Card

Terminal Emulation

TEK 4105 EM4105 *$349*

- *Tektronix 4105*
- *Tektronix 4010*
- *VT220, VT102*
- *Picture files*
- *VGA and EGA support*
- *High resolution hardcopy*

VT220 EM220 *$169*

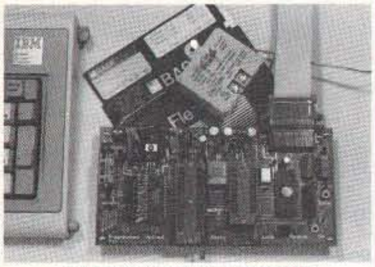
- *VT220, VT102 emulation*
- *File transfer*
- *132 column modes*
- *Color support*
- *Hot key*

■ ■ ■ ***Diversified Computer Systems, Inc.***

3775 Iris Avenue, Suite 1B
Boulder, CO 80301 (303) 447-9251
FAX: 303-447-1406

Trademarks: VT102, VT220 — DEC; Tektronix — Tektronics Inc.

Circle 78 on Reader Service Card



6805/6305 SINGLE CHIP MICROCOMPUTER DEVELOPMENT SYSTEMS

Each of three products allows the IBM PS2/PC/XT/AT to be used as a complete development system for the **Motorola** 6805 series single chip microcomputers. MCPM-1 supports the MC68705 family, MCPM-2 supports the MC1468705 family and MCPM-3 supports the MC68HC05 family. Each system is $495 and includes a programming circuit board with driver, cross assembler and Simulator/Debugger software. A system is also available for the **HITACHI 63705 ZTAT** micro.

THE ENGINEERS COLLABORATIVE
Route 3, Box 8C, Barton, VT 05822
(802) 525-3458 FAX (802) 525-3451

Circle 84 on Reader Service Card

ICs PROMPT DELIVERY!!!
SAME DAY SHIPPING (USUALLY)
QUANTITY ONE PRICES SHOWN **for AUG. 30, 1988**

OUTSIDE OKLAHOMA: NO SALES TAX

640K MOTHERBD UPGRADE: Zenith 150,
IBM PC/XT, Compaq Portable & Plus; hp Vectra

DYNAMIC RAM			
SIMM	1048Kx9	85 ns	**$495.00**
1Mbit	1048Kx1	100 ns	**38.50**
41256	256Kx1	60 ns	**14.50**
41256	* 256Kx1	80 ns	**13.75**
41256	256Kx1	100 ns	**13.75**
51258	* 256Kx1	100 ns	**12.95**
41256	256Kx1	120 ns	**12.75**
41256	256Kx1	150 ns	**11.75**
41264	+ 64Kx4	120 ns	**18.95**
EPROM			
27C1000	128Kx8	200 ns	**$37.50**
27C512	64Kx8	200 ns	**13.95**
27256	32Kx8	250 ns	**7.25**
27128	16Kx8	250 ns	**6.60**
STATIC RAM			
43256L-10	32Kx8	100 ns	**$18.95**
6264P-12	8Kx8	120 ns	**13.50**

*STATIC COLUMN DRAM
+2-PORT VIDEO RAM

80387-16
80387-20
80287-8 $245.00
8087-2 $160.00

OPEN 6½ DAYS, 7:30 AM-10 PM: SHIP VIA FED-EX ON SAT.

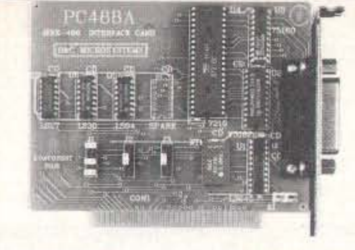
WE EXPORT ONLY TO CANADA, GUAM, PUERTO RICO & VIRGIN ISLANDS

SAT DELIVERY INCLUDED ON FED-EX ORDERS RECEIVED BY:
Th: Std Air $6/3 lb
Fr: P-1 $10.25/1 lb

MasterCard/VISA or UPS CASH COD
Factory New, Prime Parts μP∞
MICROPROCESSORS UNLIMITED, INC.
24,000 S. Peoria Ave.,
BEGGS, OK. 74421
(918) 267-4961

No minimum order. Please note that prices are subject to change. Shipping & insurance extra, & up to $1 for packing materials. **Orders received by 9 PM CST can usually be delivered the next morning, via Federal Express Standard Air @ $6.00, or guaranteed next day Priority One @ $10.25!**

Circle 140 on Reader Service Card



PC488A $145/195

LOW COST PC/XT/AT INTERFACE FOR IEEE-488 (GPIB/HPIB)

- Includes **INSTALLABLE DOS DEVICE DRIVERS** and software support for **BASIC**
- Optional language support for **C, PASCAL, FORTRAN** and **ASSEMBLY - $50**
- Selectable base I/O address, IRQ and DMA
- **CONTROLLER / TALKER / LISTENER** capability
- Customer support via dedicated 24 hours B&C Microsystems **BULLETIN BOARD**
- Quantity discounts available

VISA MC AMEX *Call today for datasheet!!*

B&C MICROSYSTEMS

355 West Olive Ave, Sunnyvale, CA 94086
PH: (408)730-5511 FAX: (408)730-5521 TELEX: 984185

Circle 21 on Reader Service Card

"INDISPENSABLE"
Jerry Pournelle, Byte, 8/87

Vopt is the fast, safe disk organizer. It will quickly eliminate the file fragmentation that slows your disk operations.

Vopt includes Vmap for viewing the organization of your disks plus numerous other utilities that test and report on the efficiency of your system.

Call for a free demo disk!

$59.95 $3 shipping/handling CA add 6.5% sales tax.

GOLDEN BOW SYSTEMS
2870 Fifth Ave., Suite 201
San Diego, CA 92103
800/284-3269

Circle 97 on Reader Service Card

The Bible Library™

29 titles: 9 bibles + 20 reference works on one CD-ROM laser disc. The most comprehensive Bible study tool available for the minister and layman $495

CD-ROM/WORM OUTLET
Save While Supplies Last

AMDEK DRIVE $639
HITACHI DRIVES .... 2 for 1 Sale

MS DOS & MAC S/W DISCOUNTED: Groliers, McGraw-Hill Science, Supermap, U.S. Atlas Geovision, Comstock — 449 photos. PC-SIG [25,000 programs], Public Domain — Alde [5,000 arced programs].

CALL 1-800-543-1734 ANYTIME
[716] 852-6711 One Day Service
C.O.D./AMEX/MC/VISA
JASON ENTERPRISE
Dept. D, 5459 Main Street
Williamsville, NY 14221

Circle 117 on Reader Service Card

Circle 77 on Reader Service Card

DISKS To Go

WE OFFER:

1. Same Day Service - All orders shipped, insured, within 24 hrs
2. Guaranteed Satisfaction - Lifetime warranty, 30-day return guarantee
3. In-stock Inventory - No delays, no disappointments
4. No Minimum Order - Quantity discounts also available
5. Pre-Approved Purchase Orders and Visa & MasterCard Accepted

AND GREAT PRICES!

5.25 Black Disks, DS/DD	**.36 ea.**
5.25 Color Disks. 8 Colors Available, DS/DD	**.46 ea.**
5.25 Black Disks, DS/HD	**.82 ea.**
5.25 Color Disks, 8 Colors Available, DS/HD	**.94 ea.**
3.5 Blue or Gray Disks, DS/DD	**1.12 ea.**
3.5 Color Disks, 5 Colors Available, DS/DD	**1.28 ea.**
3.5 High Density, Black only	**3.80 ea.**

100% certified and tested.
Error free lifetime warranty. All disks include generic white box, Tyvek sleeves, labels, write protect tabs, shrink wrapped.

LABELS To Go

CONTINUOUS FORM LABELS

Size	Across	Box Qty.	Price/1,000
2¾ x 7/16	1 across	10,000	**$1.95**
2¾ x 7/16	4 across	20,000	**$1.95**
2½ x 15/16	1 across	5,000	**$2.18**
2½ x 15/16	3 across	15,000	**$1.98**
2¾ x 2¾*	1 across	2,500	**$12.00**
2¾ x 1-7/16	1 across	5,000	**$3.00**
3 x 15/16	4 across	20,000	**$2.00**
3.3 x 15/16	4 across	20,000	**$2.05**
3½ x 15/16	1 across	5,000	**$1.90**
3½ x 15/16	2 across	10,000	**$1.90**
3½ x 15/16	3 across	15,000	**$1.90**
3½ x 15/16	4 across	20,000	**$1.90**
4 x 15/16	1 across	5,000	**$3.21**
4 x 15/16	3 across	15,000	**$3.21**
4 x 1-7/16	1 across	5,000	**$3.25**
4 x 1-7/16	3 across	15,000	**$3.25**

Prices quoted for full boxes only.
* Designed for the 3½" disk.

"The Quality Disk & Label Specialist
Since 1982"
1040 Broadway
Westville, NJ 08093
609-456-6996
FAX# 609-456-7172
All products assembled in the U.S.A.
All orders F.O.B. Westville, NJ
C.O.D. orders add $2.20

RS-232/422

Make your computer into a serial data analyser by plugging in our hardware/software:

→COMSCOPE→

No internal changes required, just plug into two serial ports on your IBM XT/AT or compatible and run our software (we have extra serial ports available). Provides data code conversion & capturing, saving to disk files. For passive data collection or generating messages and capturing reply. At this price there is no excuse not to have one! C/ w 120V adaptor........$399

IAI INDUSTRIAL AUTOMATION INC.
P.O. Box 8019 Blaine, WA 98230 FAX: 604-946-0343
Phone: 604-946-4523 or 604-270-9614

Circle 109 on Reader Service Card

CHIPCLOK™

10-year clock/calendar IN A CHIP!

Easy plug-in ■ 10-year battery
Never set date/time again
No slot needed ■ 100% compatible

NOW WORKS WITH PS/2

CHIPCLOK w/software **NOW $49.00**

30-day money-back guarantee

COMPUQUEST INC.
801 Morse Ave. ■ Schaumburg, IL 60193
1-800-722-2353
1-312-529-2552 in IL

Circle 50 on Reader Service Card

Find out how our whole family of EMU-TEK graphics terminal emulation software makes good sense for the work you do. Call today for more information.

FTG DATA SYSTEMS
(714) 995-3900
(800) 962-3900 (800) 972-3900 (Calif.)
10801 Dale St., Suite M-2
Stanton, CA 90680

Circle 89 on Reader Service Card

LONGSHINE

LONGSHINE Technology Inc.

- *Hard Disk Controller-AT/XT
- *Floppy Disk Controller
- *Tape Drive Controllers/Kit/Subsystem
- *Modem
- *EEMS RAM Card
- *Video Graphics Adapter
- *LAN Card/Repeater/Transceiver/Diskless
- *UNIX/XENIX Multi-Terminal Card
- *IBM Terminal/Emulator

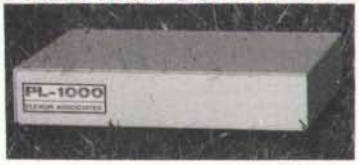
Refer to Ad on page 161.

2013 N. Capitol Ave.
San Jose, CA 95132
Tel:(408)942-1746 Fax:(408)942-1745
Telex:910-258-2016 LSTI

Trademark IBM,AT/XT IBM Corp. Unix AT&T Corp. Xenix Microsoft Corp

Circle 130 on Reader Service Card

DATA ACQUISITION TO GO
INTERFACE FOR ANY COMPUTER
FREE IBM SOFTWARE



Connects via RS-232. Fully IBM compatible. Built-in BASIC. Stand alone capability. Expandable. Battery Option. Basic system: 16 ch. 12 bit A/D, 2 ch. D/A, 32 bit Digital I/O. Expansion boards available. Direct Bus units for many computers.

(201) 299-1615
P.O. Box 246, Morris Plains, NJ 07950

ELEXOR

Circle 83 on Reader Service Card

Power Software

Batcom — Batch file compiler compiles your ".bat" files to ".exe" files to make them faster, more professional, and more capable. **$49.95.**

REDCache — speeds hard disks by up to 7 times and floppy disks by up to 55 times. LIM EMS supported. **$39.95.**

Spool — allows you to use your computer while your printer prints long documents. LIM EMS supported. **$39.95.**

RED Utilities — Contains the three programs above plus protection from accidental hard disk formatting, sorted directories, text searching, DOS wild card exceptions, and much more. For IBM PC. **$79.95.**

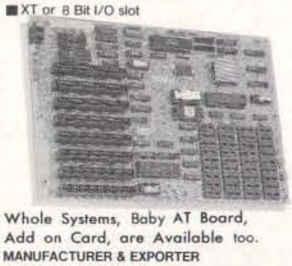
Check, COD, Visa, MasterCard.

Wenham Software Co.
5 Burley St.
Wenham, Ma. 01984
(508)-774-7036 **FREE** catalog.
Dealer inquiries invited.

Circle 230 on Reader Service Card

TRY TODAY !! BUY IT !!
THE FASTEST EXTRA 30 MAIN BOARD

Features:
- 286 XT Main Board (Extra 30)
- SI Test 7.7, Landmark Version 0.99 speed test 9 MHz
- 80286 CPU, 80287 option
- 1M RAM. 640k, 384k partition.
- Disk Caching function on board
- Compatible with Model 30
- XT or 8 Bit I/O slot



Whole Systems, Baby AT Board, Add on Card, are Available too.

MANUFACTURER & EXPORTER
PROTECH SYSTEMS CO., LTD.
P.O. Box 70 Nan Kan District Taipei Taiwan R.O.C.
Telex: 14266 PROTEK Fax: 886-2-7862254
Tel: (02)7863173-4, 7864731

Circle 175 on Reader Service Card

IBM
COMPATIBLE
KEYBOARDS

SUPREME SOURCE

contact us now

Techmate inc.
FAX: 886-2-7183242

USA: JACO COMPUTER PRODUCTS
528 Weddell Dr., Suite 7
Sunnyvale, CA 94089
Tel: (408) 747-1100

Circle 223 on Reader Service Card

IMAGING CARD

DV-01
GRAY SCALE
FRAME GRABBER

- Composite video in/out
- 256 x 240 resolution
- Digitize/display at frame speed
- 256 gray levels in
- 16 Meg. color palette out
- PC/XT/AT compatible

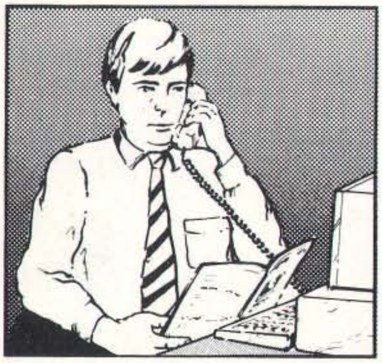
$849.00 Complete with software
VISA/MC Demo Disk available

Control Vision
P.O. Box 596, Pittsburg, KS 66762
(316) 231-6647

Circle 59 on Reader Service Card

Buy with

Confidence



In an effort to make your telephone purchasing a more successful and pleasurable activity, The Microcomputer Marketing Council of the Direct Marketing Association, Inc. offers this advice, "A knowledgeable buyer will be a successful buyer." These are specific facts you should know about the prospective seller before placing an order:

Ask These Important Questions

- *How long has the company been in business?*
- *Does the company offer technical assistance?*
- *Is there a service facility?*
- *Are manufacturer's warranties handled through the company?*
- *Does the seller have formal return and refund policies?*
- *Is there an additional charge for use of credit cards?*
- *Are credit card charges held until time of shipment?*
- *What are shipping costs for items ordered?*

Reputable computer dealers will answer all these questions to your satisfaction. Don't settle for less when buying your computer hardware, software, peripherals and supplies.

Purchasing Guidelines

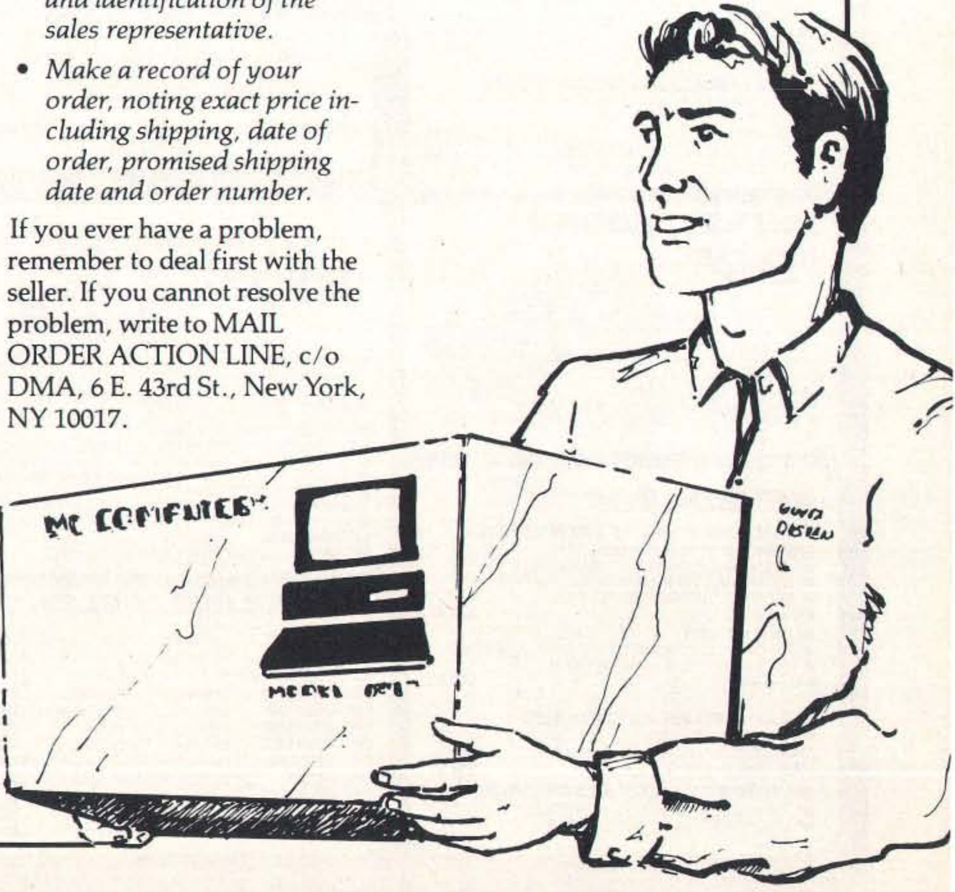
- *State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.*
- *Establish that the item is in stock and confirm shipping date.*
- *Confirm that the price is as advertised.*
- *Obtain an order number and identification of the sales representative.*
- *Make a record of your order, noting exact price including shipping, date of order, promised shipping date and order number.*

If you ever have a problem, remember to deal first with the seller. If you cannot resolve the problem, write to MAIL ORDER ACTION LINE, c/o DMA, 6 E. 43rd St., New York, NY 10017.

This message is brought to you by:

the MICROCOMPUTER
MARKETING COUNCIL
of the Direct Marketing
Association, Inc.
6 E. 43rd St.,
New York, NY 10017

MMC
MICROCOMPUTER
MARKETING COUNCIL
of the Direct Marketing Association, Inc.



© Direct Marketing Association, Inc. 1988

MMC
MICROCOMPUTER MARKETING COUNCIL
of the Direct Marketing Association, Inc.

JDR Microdevices®

▪ 30 DAY MONEY BACK GUARANTEE ▪ 1 YEAR WARRANTY ON ALL PRODUCTS ▪ TOLL-FREE TECHNICAL SUPPORT

2400 BAUD MODEMS

$129.95

$169.95

PROMETHEUS

SAVE TIME AND TELEPHONE CHARGES WITH A HIGH SPEED 2400 BAUD MODEM FROM JDR.

INTERNAL 2400 BAUD

- AUTO DIAL ANSWER
- SELF TEST ON POWER-UP
- TOUCHTONE OR PULSE DIALING
- HAYES & BELL SYSTEMS COMPATIBLE
- FULL OR HALF DUPLEX
- MIRROR II COMMUNICATIONS SOFTWARE INCLUDED

MCT-24I		$129.95
MCT-12I	1200 BAUD 1/2 CARD	$69.95
MCT-24M	2400 BAUD FOR PS/2	$249.95

EXTERNAL 2400 BAUD

- 2400/1200/300 HAYES COMPATIBLE
- 8 EASY-TO-READ STATUS LED'S
- CALL PROGRESS MONITORING & ADJUSTABLE VOLUME
- 2ND PHONE JACK FOR VOICE COMMUNICATIONS
- REQUIRES SERIAL PORT & CABLE (OPTIONAL)

MCT-24E		$169.95
MCT-12E	1200 BAUD EXTERNAL	$99.95

APPLE/MACINTOSH MODEMS

MACINTOSH 2400 BAUD EXTERNAL AS ABOVE WITH CABLE AND PROCOM-M SOFTWARE.

MCT-24EM		$199.95
MCT-24A	APPLE II 2400 BAUD MODEM	$179.95
MCT-12A	APPLE II1200 BAUD MODEM	$139.95

POCKET MODEM

$99.95

YOU'LL NEVER BE FAR FROM YOUR DATA WITH THIS 6 OUNCE HAND-HELD POCKET MODEM

- 1200/300 BAUD ▪ BATTERY & AC POWER
- SERIAL INTERFACE (DB25) ▪ 4 STATUS INDICATORS

MCT-12P

KEYBOARDS

MODULAR CIRCUIT TECHNOLOGY

ENHANCED STYLE LAYOUT

- AUTOSENSE FOR XT OR AT COMPATIBLES
- LED INDICATORS ▪ AUTO REPEAT FEATURE
- SEPARATE CURSOR PAD

MCT-5339 $79.95

84 KEY LAYOUT

- SOFTWARE AUTOSENSE FOR XT OR AT COMPATIBLES
- LED INDICATORS ▪ AUTO REPEAT

MCT-5060 $59.95

MAXI-SWITCH KEYBOARDS

WITH TACTILE FEEDBACK

MAX-5339	ENHANCED STYLE LAYOUT	$84.95
MAX-5060	84 KEY LAYOUT	$64.95

AUDIBLE "CLICK" KEYBOARD

- ENHANCED STYLE, 101 KEY KEYBOARD
- LED INDICATORS ▪ AUTO REPEAT

K-103-A $84.95

HANDY SCANNER

$249.95

INSTANT SCANNING OF IMAGES UP TO 4" WIDE

- 100, 200, 300, 400 DPI BOTH DIRECTIONS
- B&W AND 3 HALF-TONE MODES
- 32 LEVELS OF GRAY SCALE
- HERCULES, CGA AND EGA COMPATIBLE
- INCLUDES HALO DPE AND IMAGE EDITOR SOFTWARE

HS-3000

LOGITECH HIREZ MOUSE

$129.95

HIGH RESOLUTION BUS MOUSE FOR BETTER RESPONSE AND LESS HAND MOVEMENT. IDEAL FOR CAD WORK ▪ 320 DPI ▪ INCLUDES DRIVER, TEXT EDITOR & POP-UP MENUS ▪ NO PAD, POWER SUPPLY OR PORT REQUIRED

LOGITECH 3-BUTTON MOUSE

PC MAGAZINE EDITORS CHOICE! ALL MODELS HAVE SERIAL SUPPORT (COM1/COM2), 200 D.P.I. RESOLUTION, LOTUS 1-2-3 SHELL, SELF-INSTALLING SOFTWARE AND "POINT EDITOR"

LMOUSE		$79.95
LMOUSE-P	SERIAL MOUSE W/LOGIPAINT	$99.95
LMOUSE-BP	BUS MOUSE W/LOGIPAINT	$99.95
LMOUSE-BPL	BUS MOUSE W/PUBLISHER PKG	$139.95
LMOUSE-BPC	BUS MOUSE W/LOGIPAINT/CAD	$149.95

CALL OUR 24-HOUR BBS:
(408) 374-2171
FOR TECHNICAL SUPPORT, CONFERENCING, TIPS AND MORE

CITIZEN PRINTER

$219.95

A RELIABLE, FAST AND INEXPENSIVE ALL PURPOSE PRINTER THAT'S LOADED WITH FEATURES

- 9 PIN DOT MATRIX PRINT HEAD
- 180 CPS DRAFT MODE, 29 CPS NLQ MODE
- CENTRONICS PARALLEL INTERFACE, SERIAL OPTIONAL
- DUAL PITCH, DOUBLESTRIKE, ITALICS & SUPERSCRIPT
- EPSON FX & IBM GRAPHICS
- COMPRESSED, EXPANDED & EMPHASIZED PRINT
- DOT ADDRESSABLE GRAPHICS IN SIX DENSITIES

CITIZEN-180D

RC-180D REPLACEMENT RIBBON CARTRIDGE 6.95

MOLDED CABLES

CBL-PRINTER	PC PRINTER CABLE	$9.95
CBL-PRINTER-25	AS ABOVE - 25 FOOT	$15.95
CBL-PRINTER-RA	RIGHT ANGLE PRINTER	$15.95
CBL-DB25-MM	DB25 MALE TO DB25 MALE	$9.95
CBL-DB25-MF	DB25 MALE TO DB25 FEMALE	$9.95
CBL-9-SERIAL	9 PIN TO 25 PIN SERIAL	$6.95
CBL-KBD-EXT	KEYBOARD EXTENSION	$7.95
CBL-CNT-MM	36 PIN CENTRONICS-M/M	$14.95
CBL-HD-20	20 PIN HARD DISK CABLE	$3.95
CBL-HD-34	34 PIN HARD DISK CABLE	$4.95
CBL-HD-34D	34 PIN DUAL HARD DISK	$6.95
CBL-FDC-EXT	37 PIN EXTERNAL FLOPPY	$9.95

VGA COMPATIBLE PACKAGE

$649.00

- 800 X 560 MAXIMUM RESOLUTION
- 640 X 480 IN 16 COLORS
- 320 X 200 IN 256 COLORS
- IBM STYLE, ANALOG MONITOR
- FULLY VGA, EGA, CGA, HERCULES & MONOCHROME COMPATIBLE

NEC MULTISYNC II $599.95

- AUTO FREQUENCY ADJUSTMENT
- RESOLUTION AS HIGH AS 800 X560

CASPER EGA $399.95

- 640 X 200/350 RESOLUTION ▪ .31 MM DOT PITCH
- 14" BLACK MATRIX SCREEN ▪ 16 COLORS

CASPER RGB $279.95

- COLOR GREEN AMBER SWITCH ▪ .39MM DOT PITCH
- 640 X 240 RESOLUTION ▪ 14" NON-GLARE SCREEN

SAMSUNG MONO $129.95

- 12" NON-GLARE LOW DISTORTION AMBER SCREEN
- 720 X 350 RESOLUTION ▪ SWIVEL BASE

MONITOR STANDS

MODEL MS-100 $12.95

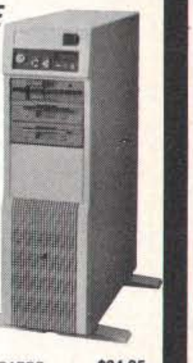
- TILTS AND SWIVELS

MODEL MS-200 $39.95

- TILTS AND SWIVELS ▪ BUILT-IN SURGE SUPRESSOR
- INDEPENDENTLY CONTROLS UP TO 5 AC OUTLETS

TOWER CASE

$299.95



SAVE DESKSPACE AND ADD STYLE TO YOUR OFFICE WITH THIS SLEEK UPRIGHT DESIGN

- ACCOMODATES ALL SIZES OF MOTHERBOARDS
- 250 WATT POWER SUPPLY INCLUDED
- MOUNTS FOR 3 FLOPPY & 4 HARD DRIVES
- TURBO & RESET SWITCH
- SPEED DISPLAY, POWER & DISK LED'S
- MOUNTING HARDWARE, FACEPLATES & SPEAKER INCLUDED

CASE-100

CASE-FLIP	FOR 8088 MOTHERBOARDS	$34.95
CASE-SLIDE	FOR 8088 MOTHERBOARDS	$39.95
CASE-70	FOR 286 MOTHERBOARDS	$89.95
CASE-JR	MINI-286 W/POWER SUPPLY	$149.95

POWER SUPPLIES

135 WATT $59.95

- UL APPROVED
- IBM XT COMPATIBLE
- +5V 15A, +12V 4.2A, -5V .5A, -12V .5A

PS-135

PS-150 150W MODEL $69.95

200 WATT $89.95

- U.L. APPROVED
- IBM AT COMPATIBLE
- +5V 22A, +12V 8A, -5V .5A, -12V .5A

PS-200

PS-250 250 WATT MODEL $129.95

JDR MICRODEVICES AND THE JDR MICRODEVICES LOGO ARE REGISTERED TRADEMARKS OF JDR MICRODEVICES. IBM, AT, PS/2 ARE TRADEMARKS OF INTERNATIONAL BUSINESS MACHINES.

Circle 119 on Reader Service Card

1.44 MB 3½" DRIVE

$149⁹⁵

- ULTRA HIGH DENSITY
- ALSO WORKS WITH 720K DISKS

FDD-1.44X BLACK FACEPLATE
FDD-1.44A BEIGE FACEPLATE

1/2 HEIGHT FLOPPY DISK DRIVES

FD-55B	5-1/4" TEAC DS/DD 360K	$99.95
FD-55G	5-1/4" TEAC DS/HD 1.2M	$129.95
M2551A	5-1/4" FUJITSU DS/DD 360K	$89.95
M2553K	5-1/4" FUJITSU DS/HD 1.2M	$119.95
FDD-360	5-1/4" DS/DD 360K	$69.95
FDD-1.2	5-1/4" DS/HD 1.2M	$109.95
FDD-3.5A	3-1/2" MITSUBISHI DS/DD(BEIGE)	$129.95
FDD-3.5X	3-1/2" MITSUBISHI DS/DD(BLACK)	$129.95

TAPE BACK-UP DRIVES

AR5240X	ARCHIVE TAPE DRIVE -XT'S & AT'S	$369.95
AR5540A	FASTER TAPE DRIVE -AT'S ONLY	$369.95
AR340	40 MB TAPE CARTRIDGES	$24.95

DISKETTES

N-MD2D	BOX OF 10 5-1/4" 360K DS/DD	$6.95
N-MD2H	BOX OF 10 5-1/4" 1.2 MB DS/HD	$13.95
N-3.5DS	BOX OF 10 3-1/2" 720K DS/DD	$16.95
N-3.5HD	BOX OF 10 3-1/2" 1.44 MB DS/HD	$49.95
N-MD2DBULK	360K DS/DD (MIN. 50 DISKS)	EA. 49¢

DRIVE ACCESSORIES

FD-ARAIL	MTG. RAILS FOR AT COMPATIBLE	$2.95
FD-55FP	BEIGE FACEPLATE FOR TEAC DRIVES	$2.95
FD-55MHW	HALF-HEIGHT MOUNTING HARDWARE	$2.95
FD-5Y	Y-POWER ADAPTOR FOR DRIVES	$2.95

Seagate HARD DISKS

Whatever your hard disk needs, we have reliable, high quality Seagate drives at the lowest prices available. Buy them alone, or with an MCT disk controller for even greater savings!

SIZE	MODEL	AVG. SPEED	HEIGHT	DRIVE ALONE	WITH MCT CONTROLLER HDC	RLL	AFH	AFH-RLL
20MB	ST-225	65 ms	Half	$225	$269	-	$339	-
30MB RLL	ST-238	65 ms	Half	$249	-	$299	-	$389
40MB	ST-251	40 ms	Half	$429	$469	-	$539	-
40MB	ST-251-1	28 ms	Half	$529	$569	-	$639	-
60MB RLL	ST-277	40 ms	Half	$499	-	$549	-	$639
30MB	ST-4038	40 ms	Full	$559	$603	-	$659	-
80MB	ST-4096	28 ms	Full	$895	$939	-	$995	-

INBOARD 386/PC

$895⁰⁰ intel®

UPGRADE YOUR XT TO A 386 FOR LESS THAN $900
- 16 MHZ PROCESSOR REPLACES 8088
- 1 MB MEMORY INSTALLED
- EXPAND TO 3 MB WITH PIGGYBACK CARD
- 5 YEAR WARRANTY

PCIB 1200

PIGGYBACK MEMORY BOARDS

PCIB1210	I MB INSTALLED	$649.00
PCIB1220	2 MB INSTALLED	$1195.00

NEW!! SIGMA VGA CARD

$279⁵⁰

100% REGISTER COMPATIBLE VGA DISPLAY CARD
- VGA, EGA, CGA, HGC & MDA COMPATIBLE
- 320 X 200 IN 256 COLORS
- 640 X 480, 800 X 600 IN 16 COLORS
- 80 X 25, 132 X 44 TEXT MODES
- SUPPORTS STANDARD DIGITAL & ANALOG MONITORS
- UTILITY SOFTWARE INCLUDED

MCT-VGA

INTERFACE CARDS
BY MODULAR CIRCUIT TECHNOLOGY

DRIVE CONTROLLERS

FLOPPY DISK CONTROLLER $29.95
SINGLE SLOT CONTROL OF 4 FLOPPIES ■ INTERFACES UP TO 4 FDD'S TO AN IBM PC OR COMPATIBLE ■ SUPPORTS DS/DD AND DS/QD W/ DOS 3.2
MCT-FDC

1.2 MB FLOPPY CONTROLLER $69.95
ADD VERSATILITY AND CAPACITY TO YOUR XT ■ SUPPORTS 2 DRIVES, CAN MIX 360K AND 1.2 MB ■ ALLOWS DATA TO FLOW FREELY FROM XT'S TO AT'S
MCT-FDC-1.2

FLOPPY/HARD CONTROLLER $139.95
XT SYSTEM SHORT OF SLOTS? THIS CARD FREES ONE UP! ■ INTERFACES UP TO 2 FDD'S & 2 HDD'S, CABLING FOR 2 FDD/1HDD ■ SUPPORTS BOTH DS/DD & DS/QD W/DOS 3.2
MCT-FH

286/386 FLOPPY/HARD $149.95
FLOPPY/ HARD DISK CONTROL IN A TRUE AT DESIGN ■ SUPPORTS UP TO 2 360K /720K/ 1.2 MB FDD'S ■ SUPPORTS 2 HDD'S USING STANDARD TABLES
MCT-AFH

HARD DISK CONTROLLER $79.95
HARD DISK CONTROL AT AN ECONOMICAL PRICE ■ SUPPORTS 16 DRIVE SIZES INCLUDING 10,20,30 & 40 MB ■ DIVIDE 1 LARGE DRIVE INTO 2 LOGICAL DRIVES
MCT-HDC

RLL CONTROLLER $119.95
TRANSFER DATA 50% FASTER ■ SUPPORTS UP TO 2 RLL HARD DRIVES ■ DESIGNED FOR XT COMPATIBLES
MCT-RLL

286/386 FLOPPY/HARD RLL $199.95
IMPROVE SPEED AND STORAGE OF YOUR AT COMPATIBLE ■ SUPPORTS UP TO 2 RLL HARD DISCS AND 2 FLOPPIES ■ SUPPORTS 360/720/ 1.2 MB FLOPPIES IN 5.25" & 3.5"
MCT-AFH-RLL

MULTIFUNCTION CARDS

MULTI I/O FLOPPY CONTROLLER $79.95
A PERFECT COMPANION FOR OUR MOTHERBOARDS ■ SUPPORTS UP TO TWO 360K FLOPPIES, 720K W/ DOS 3.2 ■ SERIAL, PARALLEL, GAME PORT, CLOCK/CALENDAR
MCT-MIO
MIO-SERIAL—2ND SERIAL PORT $15.95

MULTI I/O CARD $59.95
USE WITH MCT-FH FOR MINIMUM OF SLOTS USED ■ SERIAL PORT, CLOCK/ CALENDAR WITH BATTERY ■ PARALLEL PORT ADDRESSABLE AS LPT1 OR LPT2
MCT-IO

286/386 MULTIFUNCTION $139.95
ADDS UP TO 3 MB OF RAM TO YOUR AT ■ USER EXPANDABLE TO 1.5 MB OR 3 MB WITH OPTIONAL PIGGYBACK BOARD (0K INSTALLED) ■ INCLUDES SERIAL AND PARALLEL PORT
MCT-AMF
MCT-AMF-MC PIGGYBACK BOARD $29.95
AMF-SERIAL 2ND SERIAL PORT $24.95

286/386 MULTI I/O CARD $59.95
USE WITH MCT-AFH MINIMUM OF SLOTS USED ■ SERIAL, PARALLEL AND GAME PORTS ■ USES 16450 SERIAL SUPPORT CHIPS FOR HIGH SPEED OPS
MCT-AIO
AIO-SERIAL 2ND SERIAL PORT $24.95

MEMORY CARDS

576K RAM CARD $59.95
A CONTIGUOUS MEMORY SOLUTION IN A SHORT SLOT ■ USER SELECTABLE CONFIGURATION UP TO 576K ■ USES 64K & 256K RAM CHIPS (0K INSTALLED)
MCT-RAM

EXPANDED MEMORY CARD $129.95
2MB OF LOTUS INTEL MICROSOFT MEMORY FOR AN XT ■ CONFORMS TO LOTUS INTEL EMS ■ USER EXPANDABLE TO 2 MB ■ CAN BE USED AS EXPANDED OR CONVENTIONAL MEMORY, RAMDISK AND SPOOLER
MCT-EMS
MCT-AEMS 286/386 VERSION $139.95

DISPLAY ADAPTORS

MONOCHROME GRAPHICS $59.95
TRUE HERCULES COMPATIBILITY SUPPORTS LOTUS 1-2-3 ■ PARALLEL PRINTER PORT CONFIGURES AS LPT1 OR LPT2 ■ USES VLSI CHIPS TO ENSURE RELIABILITY
MCT-MGP

EGA ADAPTOR $149.95
100% IBM COMPATIBLE PASSES IBM EGA DIAGNOSTICS ■ 256K OF VIDEO RAM ALLOWS 640 X 350 IN 16 OF 64 COLORS ■ COMPATIBLE WITH COLOR AND MONOCHROME ADAPTORS ■ HERCULES COMPATIBLE
MCT-EGA

COLOR GRAPHICS ADAPTOR $49.95
COMPATIBLE WITH IBM GRAPHICS STANDARDS ■ SUPPORTS RGB, COLOR, & COMPOSITE MONOCHROME ■ 640/320 X 200 RESOLUTION, LIGHT PEN INTERFACE
MCT-CG

MONOGRAPHICS MULTI I/O $119.75
TOTAL SYSTEM CONTROL FROM A SINGLE SLOT! ■ CTRL 2 FLOPPIES, SERIAL, PARALLEL, GAME PORT, CLOCK CAL ■ RUN COLOR GRAPHICS SOFTWARE ON A MONOCHROME MONITOR
MCT-MGMIO

286/386 MONOGRAPHICS I/O $99.95
VIDEO DISPLAY AND I/O FUNCTIONS IN ONE CARD ■ 720 X 348 RESOLUTION, 80 & 132 COLUMN TEXT ■ PARALLEL , SERIAL & GAME PORTS
MCT-MGAIO

BARGAIN HUNTER'S CORNER

MULTIFUNCTION CARD
- INCLUDES FULL ONE YEAR WARRANTY
- XT COMPATIBLE
- 0-384K DYNAMIC RAM USING 4164'S
- SERIAL PORT & PARALLEL PRINTER PORT
- GAME CONTROLLER PORT
- CLOCK/CALENDAR
- SOFTWARE FOR RAM DISK, PRINT SPOOLER AND CLOCK/CALENDAR

MCT-MF

ONLY $59.95
SPECIAL ENDS 11/30/88

VISA MasterCard

JDR MICRODEVICES, 110 KNOWLES DRIVE, LOS GATOS, CA 95030
LOCAL (408) 866-6200 FAX (408) 378-8927 TELEX 171-110

RETAIL STORE: 1256 SOUTH BASCOM AVE., SAN JOSE, CA (408) 947-8881
HOURS: M–F 10–7 SAT. 9–5 SUN. 12–4

TERMS: MINIMUM ORDER $10.00 FOR SHIPPING AND HANDLING INCLUDE $2.50 FOR UPS GROUND AND $3.50 UPS AIR. ORDERS OVER 1 LB. AND FOREIGN ORDERS MAY REQUIRE ADDITIONAL SHIPPING CHARGES—PLEASE CONTACT THE SALES DEPARTMENT FOR THE AMOUNT. CA RESIDENTS MUST INCLUDE APPLICABLE SALES TAX. PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE. WE ARE NOT RESPONSIBLE FOR TYPOGRAPHICAL ERRORS. WE RESERVE THE RIGHT TO LIMIT QUANTITIES AND TO SUBSTITUTE MANUFACTURER. ALL MERCHANDISE SUBJECT TO PRIOR SALE. A FULL COPY OF OUR TERMS IS AVAILABLE UPON REQUEST. ITEMS PICTURED MAY ONLY BE REPRESENTATIVE.

MMC MICROCOMPUTER MARKETING COUNCIL

ORDER TOLL FREE 800-538-5000

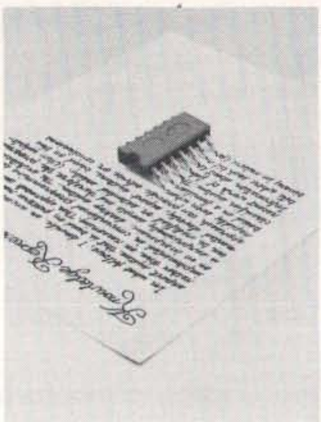
CONTINENTAL U.S. AND CANADA

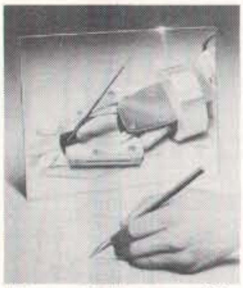
COPYRIGHT 1988 JDR MICRODEVICES

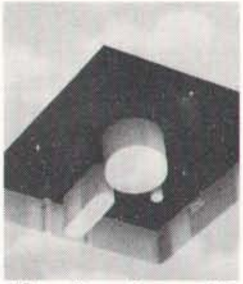
Circle 119 on Reader Service Card

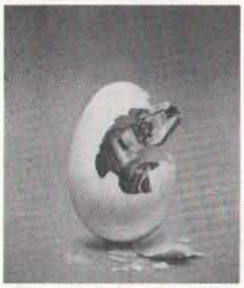
BYTE *Limited Editions*

#G Programmable Hardware $55

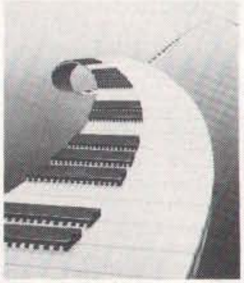

#H Word Processor $55


#A Intelligent Reflections $90


#B Storage Space $55


#C Technological Breakthrough $60

#D Number Crunching $55


#E Chips of Note $55

#F Human Dimensions $55

You've seen them on the pages of Byte — now enjoy these delightful images as stunning limited edition prints! Each exquisite, 16" × 20" reproduction is part of an edition strictly limited to only 1000 prints. The museum-quality paper is an acid-free, 100% cotton fiber stock (highly resistant to yellowing or cracking) which will preserve image color and brightness for generations.

The artist, Robert Tinney, personally inspects, signs and numbers each individual print. Accompanying the print is a Certificate of Authenticity (also signed and numbered by Tinney) which verifies the number of the edition and the destruction of the press plates.

The price of each print depends on the number of unsold prints in the edition, and is shown beneath the photos at left. If your order exceeds $100, deduct 15%. All prints are shipped flat via UPS Blue Label, and carry an unconditional 30-day guarantee.

To order, clip the coupon below. VISA, MasterCard or AmEx orders may call 1-318-826-3003.

YES! Send me the following Byte Limited Editions.

QTY.	#	TITLE	AMOUNT
			$
			$
			$
			$
			$
			$
		If your order exceeds $100, deduct 15%.	$
		$4 postage & handling ($25 overseas).	$
		TOTAL	$

☐ Send a color brochure showing your other prints.
☐ I have enclosed U.S. check or money order.
☐ C.O.D. (via UPS—stateside orders only)
☐ VISA ☐ MasterCard ☐ American Express

Card #: ____________________
Expires: ________ Signature: ____________________

SHIP MY PRINT(S) TO:

Name: ____________________
(Business): ____________________
Address: ____________________
City: ____________________
State: ____________ Zip: ____________
Country: ____________________

Mail this coupon to:

ROBERT TINNEY GRAPHICS
P.O. Box 778 • Washington, LA 70589

For VISA, MasterCard or American Express orders, or for more information
CALL 1-318-826-3003

EDITORIAL INDEX BY COMPANY

Index of companies covered in articles, columns, or news stories in this issue
Each reference is to the first page of the article or section in which the company name appears

INQUIRY #	COMPANY	PAGE
942	ALDUS	33
866	AMERICAN MICRONICS	81
	APOLLO	109
820	APPLE COMPUTER	67
	ARDENT	109
437	ARTISOFT	14
936	ASHTON-TATE	33
821	AST RESEARCH	67, 81
867		
	AT&T BELL LABORATORIES	109
935	AUTODESK	33
868	BOCA RESEARCH	81
943	BORLAND INTERNATIONAL	33
939	BRODERBUND SOFTWARE	33
	CARNEGIE-MELLON UNIVERSITY	109
869	CHEETAH INTERNATIONAL	81
	CHIPS & TECHNOLOGIES	101
870	CHRISLIN INDUSTRIES	81
871	CLUB AT	81
872	CMS ENHANCEMENTS	81
873	COMARK	81
825	COMPATIBLE SYSTEMS	67
949	COMPUTER ASSOCIATES INTERNATIONAL	33
874	COMPUTER ELEKTRONIK INFOSYS	81
	CRAIG LABORATORIES	171
944	DATASTORM TECHNOLOGIES	33
823	DATAVIZ	67
822	DAYNA COMMUNICATIONS	67
	DELL COMPUTER	101
875	DIGIBOARD	81
	DIGITAL EQUIPMENT	109
887	DIGITAL RESEARCH	142
876	EVEREX SYSTEMS	81
862	EXEC-PC	45
439	FLAGSTAFF ENGINEERING	14
950	FRONTRUNNER DEVELOPMENT	33
438	HEWLETT-PACKARD	14, 109
877	IBM	81
878	IDEASSOCIATES	81
884	IGC	142
948	INFORMIX SOFTWARE	33
826	INSIGNIA SOLUTIONS	67
879	INTEL	81
	INTERACTIVE SYSTEMS	109
863	INVENTION FACTORY	45
436	KYOCERA UNISON	14
435	LOGITECH	14
938	LOTUS DEVELOPMENT	33
955	MICRO FOCUS	53
880	MICRON TECHNOLOGY	81
883	MICROSOFT	33, 59, 75, 109, 142
940		
881	MONOLITHIC SYSTEMS	81
882	NEWER TECHNOLOGY	81
824	NOVELL	67
	OPEN SOFTWARE FOUNDATION	109
426	ORCHID TECHNOLOGY	81
952	PAPERBACK SOFTWARE INTERNATIONAL	33
427	PBJ	81
428	PROFIT SYSTEMS	81
429	QUADRAM	81
885	QUARTERDECK OFFICE SYSTEMS	142
	SANTA CRUZ OPERATION	109
934	SEASIDE SOFTWARE	33
	SILICON GRAPHICS	109
941	SOFTKLONE DISTRIBUTING	33
945	SOFTWARE PUBLISHING	33
430	STB SYSTEMS	81
	SUN MICROSYSTEMS	109
886	SUNNY HILL SOFTWARE	142
431	SUNTEK INFORMATION SYSTEMS	81
946	SYMANTEC	33
947		
432	TALL TREE SYSTEMS	81
433	TECMAR	81
937	THE FINOT GROUP	33
888	THE SOFTWARE LINK	142
864	THOUSAND OAKS TECHNICAL DATABASE	45
827	TOPS	67
865	UTILITIES EXCHANGE	45
434	VUTEK SYSTEMS	81
951	XEROX	33
	XEROX PALO ALTO RESEARCH CENTER	109
953	XYQUEST	33

BYTE ADVERTISING SALES STAFF:

Dennis J. Riley, Director of Sales, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281
Jennifer L. Bartel, West Coast Regional Sales Manager, 8111 LBJ Freeway, Suite 1350, Dallas, Tx 75251, tel. (214) 644-1111

NEW ENGLAND
ME, NH, VT, MA, RI, ONTARIO
CANADA & EASTERN CANADA
John C. Moon **(617) 262-1160**
McGraw-Hill Publications
575 Boylston Street
Boston, MA 02116

ATLANTIC
NY, NYC, CT, NJ (NORTH)
Leah G. Rabinowitz **(212) 512-2096**
McGraw-Hill Publications
1221 Avenue of the Americas—
36th Floor
New York, NY 10020

(203) 968-7111
McGraw-Hill Publications
Building A—3rd Floor
777 Long Ridge Road
Stamford, CT 06902

EAST
PA, NJ (SOUTH),
MD, VA, W.VA, DE, D.C.
(215) 496-3833
McGraw-Hill Publications
Three Parkway
Philadelphia, PA 19102

SOUTHEAST
NC, SC, GA, FL, AL, TN
Thomas Tolbert **(404) 252-0626**
McGraw-Hill Publications
4170 Ashford-Dunwoody Road
Suite 420
Atlanta, GA 30319

MIDWEST
IL, MO, KS, IA, ND, SD, MN,
KY, OH, WI, NB, IN, MI, MS
Bob Denmead **(312) 751-3740**
McGraw-Hill Publications
Blair Building
645 North Michigan Ave.
Chicago, IL 60611

SOUTHWEST,
ROCKY MOUNTAIN
CO, WY, OK, TX, AR, LA, UT
Karl Heinrich **(713) 462-0757**
McGraw-Hill Publications
7600 W. Tidwell Rd.—Suite 500
Houston, TX 77040

SOUTH PACIFIC
SOUTHERN CA, AZ, NM,
LAS VEGAS
Jack Anderson **(714) 557-6292**
McGraw-Hill Publications
3001 Red Hill Ave.
Building #1—Suite 222
Costa Mesa, CA 92626

Tom Harvey **(213) 480-5243**
McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010

NORTH PACIFIC
HI, WA, OR, ID, MT,
NORTHERN CA,
NV (except LAS VEGAS),
W. CANADA
Mike Kisseberth **(415) 362-4600**
McGraw-Hill Publications
425 Battery Street
San Francisco, CA 94111

Bill McAfee **(415) 349-4100**
McGraw-Hill Publications
951 Mariner's Island Blvd.—
3rd Floor
San Mateo, CA 94404

BYTE BITS (2x3)
Dan Harper **(603) 924-6830**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

The Buyer's Mart (1x2)
Mark Stone **(603) 924-3754**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Regional Advertising
Scott Gagnon **(603) 924-6830**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Elisa Lister **(603) 924-6830**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Liz Coyman **(603) 924-9281**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE Deck Mailings
National
Ed Ware **(603) 924-6166**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

A/E/C Computing Deck
Computing for Engineers
Mary Ann Goulding
(603) 924-9281
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

International Advertising Sales Staff:

Mr. Hans Csokor
Publimedia
Reisnerstrasse 61
A-1037 Vienna, Austria
222 75 76 84

Mrs. Gurit Gepner
McGraw-Hill Publishing Co.
PO Box 2156
Bat Yam, 59121 Israel
3 866 561 321 39

Ros Weyman
Serving Germany, Austria, & Switzerland
McGraw-Hill Publishing Co.
34 Dover St.
London W1X 4BR
England 01 493 1451

Mrs. Maria Sarmiento
Pedro Teixeira 8, Off. 320
Iberia Mart 1
Madrid 4, Spain
1 45 52 891

Michael Karnig
Andrew Karnig & Associates
Finnbodavagen
S-131 31 Nacka, Sweden
8-44 0005

Mr. Alain Faure
McGraw-Hill Publishing Co.
128 Faubourg Saint Honore
75008 Paris
France
(1) 42-89-03-81

Karen Lennie
McGraw-Hill Publishing Co.
34 Dover St.
London W1X 4BR
England 01 493 1451

Emilio Zerboni
McGraw-Hill Publishing Co.
Via Flavio Baracchini 1
20123 Milan, Italy
(2) 89010103

Seavex Ltd.
400 Orchard Road, #10-01
Singapore 0923
Republic of Singapore
Tel: 734-9790
Telex: RS35539 SEAVEX

Seavex Ltd.
503 Wilson House
19-27 Wyndham St.
Central, Hong Kong
Tel: 5-260149
Telex: 60904 SEVEX HX

Hiro Morita
McGraw-Hill Publishing Co.
Overseas Corp.
Room 1528
Kasumigaseki Bldg.
3-2-5 Kasumigaseki,
Chiyoda-Ku
Tokyo 100, Japan
3 581 9811

Mr. Ernest McCrary
Empresa Internacional de
Comunicacoes Ltda.
Rua da Consolacao, 222
Conjunto 103
01302 Sao Paulo, S.P., Brasil
Tel: (11) 259-3811
Telex: (100) 32122 EMBN

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

Advertising Supplement included with this issue:
Jade Computer (U.S. and Canada Subscribers)

Alphabetical Index to Advertisers

Inquiry No.		Page No.
2	ABRA CADABRA SOFTWARE	219
3	AK SYSTEMS	217
4	ALDUS	140,141
5	ALDUS	140,141
6	ALPHA PRODUCTS	233
8	ALTEX ELECTRONICS	237
9	AMERICAN DIGICOM	104
10	AMERICAN RESEARCH	203
11	AMERICAN RESEARCH	203
12	AMERICAN SEMICONDUCTOR	235
13	AMERICAN SEMICONDUCTOR	235
14	AMERICAN SMALL BUSINESS	123
*	AMPRO	184
15	ANNABOOKS	234
17	APTECH SYSTEMS	105
*	AST	107
18	ASTRO SYSTEMS	122
19	ASYST SOFTWARE TECH	49
20	AVOCADO	170
21	B & C MICRO SYSTEMS	239
22	BASF	87
23	BAY TECHNICAL ASSOC.	44
24	BECKMAN ASSOCIATES	46
25	BEST COMPUTER	80
26	BEST COMPUTER	80
27	BINARY ENGINEERING	26
28	BLAISE	137
30	BOCA RESEARCH	34
31	BOFFIN LTD	121
32	BORLAND	CII
33	BORLAND	CII
34	BORLAND	1
35	BORLAND	1
36	BORLAND	133
37	BORLAND	133
38	BP MICROSYSTEMS	232
38	BP MICROSYSTEMS	232
*	BUYERS MART	223-229
*	BYTE CIRCULATION	208
*	BYTE SUB. MESSAGE	98
*	BYTE SUB. SERVICE	181
40	CANETICS	232
41	CAPITAL EQUIPMENT	97
42	CENTRAL POINT S/W	50,51
43	CGRS MICROTECH	196
45	CLEO SOFTWARE	66
46	CMS ENHANCEMENTS	193
47	CMS ENHANCEMENTS	193
48	COMPACT DISK PRODUCTS	221
252	COMPUCLASSICS	211
253	COMPUCLASSICS	211
49	COMPUCOM CORP.	236
50	COMPUQUEST	240
51	COMPUTER AGE, LTD	232
52	COMPUTER BOOK CLUB, THE	17
53	COMP. DISC. WAREHOUSE	175
54	COMPUTER TECHNICAL RSCH	96
55	COMPUTER TECHNICAL RSCH	96
56	CONTECH	236
57	CONTROL SYSTEMS	11
58	CONTROL SYSTEMS	11
59	CONTROL VISION	240
60	CORECO	199
61	CTX	71
62	CTX	71
63	CUESTA SYSTEMS	60
64	CUESTA SYSTEMS	60
65	CYBER RESEARCH	196
66	DATAWORLD	183
67	DATAWORLD	183
*	DATRAN CORP	127
68	DAYSTAR COMPUTING	128
72	DELL COMPUTERS	4-7
73	DIGIBOARD	124
69	DIGITAL COMPOSITION SYS.	20
74	DIGITAL PRODUCTS	151
75	DISC INTERNATIONAL	236
76	DISKCOTECH	232
77	DISKS TO GO	239
78	DIVERSIFIED COMP. SYS.	239
79	DSP DEVELOPMENT CORP.	40
80	DYNAMIC ELECTRONICS	232
81	E-TECH RESEARCH	232
82	ECOSOFT	119
83	ELEXOR	240
84	ENGINEERS COLLABORATIVE	239
85	EVEREX	30,31
86	EVEREX	30,31
236	FLAGSTAFF ENGINEERING	32
237	FLAGSTAFF ENGINEERING	32
89	FTG DATA SYSTEMS	240
91	GALACTICOMM	39
92	GATEWAY 2000	41
93	GENERIC SOFTWARE	79
94	GENERIC SOFTWARE	79
95	GENOA	55
96	GOLD HILL COMPUTERS	99
97	GOLDEN BOW SYSTEMS	239
98	GRAFPOINT	234
99	GTEK, INC.	135
101	HAMMERLY COMP.SERVICES	61
102	HARD DISK DRIVES INT'L	168
103	HARD DISK DRIVES INT'L	168
104	HAUPPAUGE COMP. WORKS	95
105	HAYES MICROCOMPUTER	2
106	HOOLEON	149
107	HOOLEON	149
108	HORSTMANN SOFTWARE	48
109	IAI INDUSTRIAL AUTOMATION	240
*	IBM CORP.	12,13
110	IC EXPRESS	234
111	INFORMATION BUILDERS	69
112	INFORMIX SOFTWARE	64,65
113	INTERACTIVE SYS CORP	108
114	INTERACTIVE SYS CORP	108
115	ITAC	106
116	JAMECO	230,231
117	JASON ENTERPRISE	239
118	JENSEN & PARTNERS, INC.	47
119	J.D.R. MICRODEVICES	242,243
120	KADAK	138
121	KAO CORP	167
122	KEA SYSTEMS	126
123	KISS ENGINEERING	70
124	KONAN	200
125	KONAN	200
126	LIONHEART PRESS	196
129	LONG SHINE TECHNOLOGY	161
130	LONG SHINE TECHNOLOGY	240
*	LOTUS DEV.CORP.	42,43
132	MANZANA	63
133	MAP INFO SYSTEMS	28
134	MAX GROUP	165
135	MAX GROUP	165
*	MAXELL DATA PRODUCTS	CIV
136	MEDIALOGIC	197
137	MERRITT COMPUTING	216
*	MICROCOMP. MKTG COUNCIL	241
138	MICRO EXPRESS	152
139	MICRO EXPRESS	152
140	MICROPROCESSOR UNLTD	239
141	MICROSOFT PRESS	115
142	MICROSOFT PRESS	115
143	MICROSTAR LABS	234
145	MICROWAY	CIII
250	MITSUBISHI MONITORS	18,19
251	MITSUBISHI MONITORS	18,19
149	MITSUBISHI PRINTERS	21
150	MITSUBISHI PRINTERS	21
151	NANAO	100
152	NANAO	100
153	NANTUCKET	77
154	NATIONAL INSTRUMENTS	174
155	NATURAL MICROSYSTEMS	86
156	NOHAU CORP	238
157	OKIDATA	159
158	OMEGA MICRO SYSTEMS	134
177	ONLINE STORE	191
159	ON TARGET ASSOCIATES	78
160	ON TARGET ASSOCIATES	234
*	ORACLE	25
162	ORION	74
163	OSBORNE MCGRAW-HILL	205
164	OVERLAND DATA	234
165	PACIFIC COMPUTER	238
166	PACIFIC COMPUTER	238
167	PATTON & PATTON	118
168	PAUL MACE SOFTWARE	163
169	PC DESIGN	113
170	PC NETWORK	189
172	PERSONAL TEX	182
173	PRECISION DATA PROD	234
174	PRECISION PLUS SOFTWARE	138
*	PRIORITY ONE ELECTR.	249-264
249	PRINCETON GRAPHIC	186
254	PROTECH MKT. INC.	219
175	PROTECH SYSTEMS CO.,LTD.	240
245	P.C. PLUS	88,89
178	QIC RESEARCH	27
29	QSET	214
179	QUA TECH	126
180	QUA TECH	234
181	QUALSTAR	238
182	QUANTUM	116
183	QUARTERDECK	58
184	QUARTERDECK	58
185	RADIO SHACK	139
186	RAINBOW TECH	136
187	RAINBOW TECH	136
188	RAINBOW TECH	195
189	RAINBOW TECH	195
190	RCS TECHNOLOGY	216
191	ROSE ELECTRONICS	171
243	ROSE ELECTRONICS	236
244	ROSE ELECTRONICS	236
193	SABINA INT'L	236
194	SAFEWARE	236
195	SANTA CRUZ OPERATION	9
196	SCIENTIFIC COMP.ASSOC.	236
197	SCITECH CORP.	238
198	SEALEVEL SYSTEMS INC.	234
199	SENDON	221
200	SHECOM	185
201	SHECOM	185
202	SIMPLE NET SYSTEMS	155
203	SIMPLE NET SYSTEMS	155
205	SMART LINK COMP. SYS.	214
206	SN'W ELECTRONICS	62
207	SOFT WAREHOUSE	215
208	SOFTWARE DIRECTION	35
209	SOFTWARE DIRECTION	37
234	SOFTWARE INTERPHASE	76
235	SOFTWARE INTERPHASE	76
213	SOFTWARE SECURITY	125
214	SOTA TECHNOLOGY	23
215	SPSS	176
216	STREET ELECTRONICS	70
217	SUNTRONICS	103
218	SYSGEN	52
223	TECHMATE INC.	240
224	TELEBYTE TECHNOLOGY INC.	16
225	TIGERTRONICS	217
*	TINNEY, ROBT. GRAPHICS	244
240	TOSHIBA	56,57
241	TOSHIBA	56,57
226	TRILOBYTE	164
227	TRUEVISION	147
228	V3 CORPORATION	36
246	VNS AMERICA	93
247	VNS AMERICA	173
248	VNS AMERICA	207
229	WAREHOUSE DATA	111
230	WENHAM SOFTWARE	240
*	WILEY & SONS	120
231	WINTEK	29
*	WORTHINGTON DATA SOL.	22
232	ZEO'S INTL. LTD.	72,73
233	ZERICON	157

** Correspond directly with company.*

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company

Index to Advertisers by Product Category

HARDWARE

300 ADD INS

Inquiry No.		Page No.
6	ALPHA PRODUCTS	233
*	AST	107
20	AVOCADO	170
21	B & C MICRO SYSTEMS	239
30	BOCA RESEARCH	34
41	CAPITAL EQUIPMENT	97
43	CGRS MICROTECH	196
51	COMPUTER AGE, LTD.	232
57	CONTROL SYSTEMS	11
58	CONTROL SYSTEMS	11
59	CONTROL VISION	240
*	DATRAN CORP.	127
91	GALACTICOMM	39
95	GENOA	55
124	KONAN	200
125	KONAN	200
129	LONG SHINE TECHNOLOGY	240
130	LONG SHINE TECHNOLOGY	161
145	MICROWAY	CIII
155	NATURAL MICROSYSTEMS	86
156	NOHAU CORP	238
159	ON TARGET ASSOCIATES	78
180	QUA TECH	234
181	QUALSTAR	238
243	ROSE ELECTRONICS	236
244	ROSE ELECTRONICS	236
197	SCITECH CORP.	238
198	SEALEVEL SYSTEMS INC.	234
214	SOTA TECHNOLOGY	23
216	STREET ELECTRONICS	70
227	TRUEVISION	147

301 DRIVES

Inquiry No.		Page No.
18	ASTRO SYSTEMS	122
46	CMS ENHANCEMENTS	193
47	CMS ENHANCEMENTS	193
132	MANZANA	63
218	SYSGEN	52
225	TIGERTRONICS	217

302 HARDWARE PROGRAMMERS

Inquiry No.		Page No.
38	BP MICROSYSTEMS	232
38	BP MICROSYSTEMS	232
99	GTEK, INC.	135

303 INSTRUMENTATION

Inquiry No.		Page No.
43	CGRS MICROTECH	196
79	DSP DEVELOPMENT CORP.	40
83	ELEXOR	240
109	IAI INDUSTRIAL AUTOMATION	240
143	MICROSTAR LABS	234
154	NATIONAL INSTRUMENTS	174
162	ORION	74
228	V3 CORPORATION	36

304 KEYBOARDS/MICE

Inquiry No.		Page No.
106	HOOLEON	149
107	HOOLEON	149
115	ITAC	106
223	TECHMATE INC.	240
*	WORTHINGTON DATA SOLTN.	22

305 MASS STORAGE

Inquiry No.		Page No.
3	AK SYSTEMS	217
22	BASF	87
74	DIGITAL PRODUCTS	151
236	FLAGSTAFF ENGINEERING	32
237	FLAGSTAFF ENGINEERING	32
121	KAO CORP.	167
*	MAXELL DATA PRODUCTS	CIV
164	OVERLAND DATA	234
182	QUANTUM	116
224	TELEBYTE TECHNOLOGY INC.	16

*** MISCELLANEOUS**

Inquiry No.		Page No.
50	COMPUQUEST	240
84	ENGINEERS COLLABORATIVE	239
136	MEDIALOGIC	197
137	MERRITT COMPUTING	216
190	RCS TECHNOLOGY	216

306 MODEMS/MULTIPLEXORS

Inquiry No.		Page No.
49	COMPUCOM CORP.	236
81	E-TECH RESEARCH	232
91	GALACTICOMM	39
105	HAYES MICROCOMPUTER	2
123	KISS ENGINEERING	70
155	NATURAL MICROSYSTEMS	86

307 MONITORS

Inquiry No.		Page No.
61	CTX	71
62	CTX	71
250	MITSUBISHI MONITORS	18,19
251	MITSUBISHI MONITORS	18,19
151	NANAO	100
152	NANAO	100
249	PRINCETON GRAPHIC	186

308 NETWORK HARDWARE

Inquiry No.		Page No.
23	BAY TECHNICAL ASSOC.	44
73	DIGIBOARD	124
191	ROSE ELECTRONICS	171

309 POWER SUPPLIES

Inquiry No.		Page No.
63	CUESTA SYSTEMS	60
64	CUESTA SYSTEMS	60
199	SENDON	221

310 PRINTERS/PLOTTERS

Inquiry No.		Page No.
149	MITSUBISHI PRINTERS	21
150	MITSUBISHI PRINTERS	21
157	OKIDATA	159
243	ROSE ELECTRONICS	236
244	ROSE ELECTRONICS	236
233	ZERICON	157

311 SCANNERS/DIGITIZERS

Inquiry No.		Page No.
60	CORECO	199

312 SOFTWARE SECURITY

Inquiry No.		Page No.
254	PROTECH MKT. INC.	219
186	RAINBOW TECH	136
187	RAINBOW TECH	136
188	RAINBOW TECH	195
189	RAINBOW TECH	195
213	SOFTWARE SECURITY	125

313 SYSTEMS

Inquiry No.		Page No.
9	AMERICAN DIGICOM	104
10	AMERICAN RESEARCH	203
11	AMERICAN RESEARCH	203
*	AMPRO	184
*	AST	107
25	BEST COMPUTER	80
26	BEST COMPUTER	80
66	DATAWORLD	183
67	DATAWORLD	183
72	DELL COMPUTERS	4-7
85	EVEREX	30,31
86	EVEREX	30,31
92	GATEWAY 2000	41
104	HAUPPAUGE COMP. WORKS	95
*	IBM CORP.	12,13
113	INTERACTIVE SYS.CORP.	108
114	INTERACTIVE SYS.CORP.	108
138	MICRO EXPRESS	152
139	MICRO EXPRESS	152
145	MICROWAY	CIII
158	OMEGA MICRO SYSTEMS	134
165	PACIFIC COMPUTER	238
166	PACIFIC COMPUTER	238
169	PC DESIGN	113
175	PROTECH SYSTEMS CO.,LTD.	240
178	QIC RESEARCH	27
185	RADIO SHACK	139
217	SUNTRONICS	103
240	TOSHIBA	56,57
241	TOSHIBA	56,57
246	VNS AMERICA	93
247	VNS AMERICA	173
248	VNS AMERICA	207
232	ZEOS INT'L. LTD.	72,73

SOFTWARE

314 IBM/MSDOS APPLICATIONS —Business/Office

Inquiry No.		Page No.
2	ABRA CADABRA SOFTWARE	219
24	BECKMAN ASSOCIATES	46
36	BORLAND	133
37	BORLAND	133
89	FTG DATA SYSTEMS	240
97	GOLDEN BOW SYSTEMS	239
111	INFORMATION BUILDERS	69
112	INFORMIX SOFTWARE	64,65
126	LIONHEART PRESS	196
*	LOTUS DVLPMT. CORP.	42,43
153	NANTUCKET	77
*	ORACLE	25

315 IBM/MSDOS APPLICATIONS —Scientific/Technical

Inquiry No.		Page No.
17	APTECH SYSTEMS	105
19	ASYST SOFTWARE TECH	49
27	BINARY ENGINEERING	26
40	CANETICS	232
82	ECOSOFT	119
108	HORSTMANN SOFTWARE	48
126	LIONHEART PRESS	196
167	PATTON & PATTON	118
172	PERSONAL TEX	182
174	PRECISION PLUS SOFTWARE	138
196	SCIENTIFIC COMP. ASSOC.	236
207	SOFT WAREHOUSE	215
215	SPSS	176
226	TRILOBYTE	164

316 IBM/MSDOS—CAD

Inquiry No.		Page No.
14	AMERICAN SMALL BUSINESS	123
93	GENERIC SOFTWARE	79
94	GENERIC SOFTWARE	79
231	WINTEK	29

317 IBM/MSDOS—LAN

Inquiry No.		Page No.
202	SIMPLE NET SYSTEMS	155
203	SIMPLE NET SYSTEMS	155
227	TRUEVISION	147

318 IBM/MSDOS—LANGUAGES

Inquiry No.		Page No.
32	BORLAND	CII
33	BORLAND	CII
34	BORLAND	1
35	BORLAND	1
96	GOLD HILL COMPUTERS	99
179	QUA TECH	126
208	SOFTWARE DIRECTION	35

319 IBM/MSDOS—UTILITIES

Inquiry No.		Page No.
28	BLAISE	137
32	BORLAND	CII
33	BORLAND	CII
42	CENTRAL POINT S/W	50,51
68	DAYSTAR COMPUTING	128
101	HAMMERLY COMPUTER SERV.	61
118	JENSEN & PARTNERS, INC.	47
209	SOFTWARE DIRECTION	37
234	SOFTWARE INTERPHASE	76
235	SOFTWARE INTERPHASE	76
230	WENHAM SOFTWARE	240

320 IBM/MSDOS—COMMUNICATIONS

Inquiry No.		Page No.
45	CLEO SOFTWARE	66
78	DIVERSIFIED COMP.	239
98	GRAFPOINT	234
122	KEA SYSTEMS	126
*	ORACLE	25

325 IBM/MSDOS—GRAPHICS

Inquiry No.		Page No.
98	GRAFPOINT	234
133	MAP INFO SYSTEMS	28
168	PAUL MACE SOFTWARE	163

READER SERVICE

Advertising Supplement included with this issue:
Jade Computer (U.S. and Canada Subscribers)

* Correspond directly with company.

321 MAIL ORDER/RETAIL

Inquiry No.		Page No.
8	ALTEX ELECTRONICS	237
12	AMERICAN SEMICONDUCTOR	235
13	AMERICAN SEMICONDUCTOR	235
31	BOFFIN LTD.	121
*	BUYERS MART	223-229
48	COMPACT DISK PRODUCTS	221
252	COMPUCLASSICS	211
253	COMPUCLASSICS	211
53	COMPUTER DISC. WRHSE.	175
56	CONTECH	236
75	DISC INTERNATIONAL	236
76	DISKCOTECH	232
77	DISKS TO GO	239
80	DYNAMIC ELECTRONICS	232
102	HARD DISK DRIVES INT'L.	168
103	HARD DISK DRIVES INT'L.	168
110	IC EXPRESS	234
116	JAMECO	230,231
119	J.D.R. MICRODEVICES	242,243
134	MAX GROUP	165
135	MAX GROUP	165
*	MICROCOMP. MKTG.CNCL.	241
140	MICROPROCESSOR UNLTD.	239
158	OMEGA MICRO SYSTEMS	134
177	ONLINE STORE	191
170	PC NETWORK	189
173	PRECISION DATA PROD.	234
*	PRIORITY ONE ELECTR.	249-264
245	P.C. PLUS	88,89
193	SABINA INT'L.	236
200	SHECOM	185
201	SHECOM	185
206	SN'W ELECTRONICS	62
229	WAREHOUSE DATA	111

322 EDUCATIONAL/INSTRUCTIONAL

Inquiry No.		Page No.
15	ANNABOOKS	234
*	BYTE CIRCULATION	208
*	BYTE SUB. MESSAGE	98
*	BYTE SUB. SERVICE	181
52	COMPUTER BOOK CLUB, THE	17
54	COMPUTER TECHNICAL RSCH.	96
55	COMPUTER TECHNICAL RSCH.	96
65	CYBER RESEARCH	196
117	JASON ENTERPRISE	239
141	MICROSOFT PRESS	115
142	MICROSOFT PRESS	115
163	OSBORNE MCGRAW-HILL	205
*	WILEY & SONS	120

323 DESKTOP PUBLISHING

Inquiry No.		Page No.
4	ALDUS	140,141
5	ALDUS	140,141
69	DIGITAL COMPOSITION SYS.	20

* MISCELLANEOUS

Inquiry No.		Page No.
160	ON TARGET ASSOCIATES	234
194	SAFEWARE	236
205	SMART LINK COMP. SYS.	214
*	TINNEY,ROBERT GRAPHICS	244

324 OPERATING SYSTEMS

Inquiry No.		Page No.
120	KADAK	138
29	QSET	214
183	QUARTERDECK	58
184	QUARTERDECK	58
195	SANTA CRUZ OPERATION	9

** Correspond directly with company.*

TIPS

SUBSCRIBERS ONLY!*

Use BYTE's Telephone Inquiry Processing System
Using TIPS can bring product information as much as 10 days earlier.

SEND FOR YOUR SUBSCRIBER I.D. CARD

1) If you are a new subscriber or have lost your I.D. card, circle #1 on the Reader Service Card; **attach mailer label**. We will immediately send your personal TIPS subscriber card.

GET PREPARED

2) Write your Subscriber Number, as printed on your Subscriber I.D. Card, in boxes in Step 5 below. (Do not add 0's to fill in blank boxes)

3) Write numbers for information desired in boxes in Step 7b below. (Do not add 0's to fill in blank boxes.)

CALL TIPS

4) Now, on a Touch-Tone telephone dial: **(413) 442-2668** and wait for voice commands.

ENTER YOUR SUBSCRIBER AND ISSUE NUMBERS

5) When TIPS says: "Enter Subscriber Number"
(Enter by pushing the numbers and symbols [# or * enclosed in the boxes] on telephone pad ignoring blank boxes)
Enter ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ # #

6) When TIPS says "Enter magazine code & issue code"
Enter 1 # 1 3 8 # #

ENTER YOUR INQUIRIES

7a) When TIPS says "Enter (next) Inquiry Number"
Enter one inquiry selection from below (ignore blank boxes)

b) Repeat 7a as needed (maximum 17 inquiry numbers)

1. ☐ ☐ ☐ # #
2. ☐ ☐ ☐ # #
3. ☐ ☐ ☐ # #
4. ☐ ☐ ☐ # #
5. ☐ ☐ ☐ # #
6. ☐ ☐ ☐ # #
7. ☐ ☐ ☐ # #
8. ☐ ☐ ☐ # #
9. ☐ ☐ ☐ # #
10. ☐ ☐ ☐ # #
11. ☐ ☐ ☐ # #
12. ☐ ☐ ☐ # #
13. ☐ ☐ ☐ # #
14. ☐ ☐ ☐ # #
15. ☐ ☐ ☐ # #
16. ☐ ☐ ☐ # #
17. ☐ ☐ ☐ # #

END SESSION

8) End session by entering * * 9 1 # #

9) Hang up after hearing final message
If you are a subscriber and need assistance, call (603) 924-9281.

Available 24 Hours, 7 Days a Week

If you are not a subscriber fill out the subscription card found in this issue or, call BYTE Circulation 800-423-8272.
***Domestic and Canadian Subscribers Only!**

FREE Information Retrieval Service

To assist you in making your evaluations, purchasing decisions, or recommendations, you can request further information directly from the manufacturer or service company on products and services advertised in this issue. There is no charge, no obligation. Just complete and mail the attached self-addressed reply card, and we'll do the rest.

1. Circle numbers on reply card which correspond to numbers assigned to items of interest to you.
2. Check all the appropriate answers to questions "A" through "F".
3. Print your name and address and mail.

Fill out this coupon carefully. PLEASE PRINT. Requests cannot be honored unless the code is included. This card is valid for 6 months from cover date.

A. What is your primary job function? (Check one only)
1 ☐ Business Owner, General Management, Administrative
2 ☐ MIS/DP, Programming
3 ☐ Engineering/Scientific, R&D
4 ☐ Professional (law, medicine, accounting)
5 ☐ Other

B. How many people does your company employ?
1 ☐ 25 or fewer
2 ☐ 26–99
3 ☐ 100–499
4 ☐ 500–999
5 ☐ 1000 or more

C. Reason for request: (Check all that apply).
1 ☐ Business use for yourself
2 ☐ Business use for your company
3 ☐ Personal use

D. Your next step after information is received:
1 ☐ Purchase order
2 ☐ Evaluation
3 ☐ Specification/Recommendation

E. Please indicate the product categories for which you influence the selection or purchase at your (or your client's) company or organization. (Check all that apply).
1 ☐ Microcomputers
2 ☐ Peripherals
3 ☐ Software
4 ☐ Accessories and supplies

F. For how many microcomputers do you influence the purchase of products at your (or your client's) company or organization?
1 ☐ 1
2 ☐ 2–4
3 ☐ 5–9
4 ☐ 10 or more

Name ______________________

Title ______________________

Company ______________________

Address ______________________

City ______________ *Country* ______________

Code ______________ *Telephone* ______________

CIRCLE FOR FREE INFORMATION

48IRSE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162
163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189
190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216
217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243
244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297
298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324
325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351
352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378
379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405
406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432
433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486
487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513
514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567
568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594
595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621
622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648
649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675
676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702
703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729
730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756
757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783
784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810
811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837
838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864
865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891
892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918
919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945
946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972
973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999

PLACE
POSTAGE
HERE

BYTE

P.O. Box 929
Yardley
Birmingham
England, B25 85

FREE Information Retrieval Service

To assist you in making your evaluations, purchasing decisions, or recommendations, you can request further information directly from the manufacturer or service company on products and services advertised in this issue. There is no charge, no obligation. Just complete and mail the attached self-addressed reply card, and we'll do the rest.

1 Circle numbers on reply card which correspond to numbers assigned to items of interest to you.

2 Check all the appropriate answers to questions "A" through "F".

3 Print your name and address and mail.

PLACE
POSTAGE
HERE

BYTE
P.O. Box 929
Yardley
Birmingham
England, B25 85

Fill out this coupon carefully. PLEASE PRINT. Requests cannot be honored unless the code is included. This card is valid for 6 months from cover date.

A. What is your primary job function? (Check one only)
1 ☐ Business Owner, General Management, Administrative
2 ☐ MIS/DP, Programming
3 ☐ Engineering/Scientific, R&D
4 ☐ Professional (law, medicine, accounting)
5 ☐ Other

B. How many people does your company employ?
1 ☐ 25 or fewer
2 ☐ 26–99
3 ☐ 100–499
4 ☐ 500–999
5 ☐ 1000 or more

C. Reason for request: (Check all that apply).
1 ☐ Business use for yourself
2 ☐ Business use for your company
3 ☐ Personal use

D. Your next step after information is received:
1 ☐ Purchase order
2 ☐ Evaluation
3 ☐ Specification/Recommendation

E. Please indicate the product categories for which you influence the selection or purchase at your (or your client's) company or organization. (Check all that apply).
1 ☐ Microcomputers
2 ☐ Peripherals
3 ☐ Software
4 ☐ Accessories and supplies

F. For how many microcomputers do you influence the purchase of products at your (or your client's) company or organization?
1 ☐ 1
2 ☐ 2–4
3 ☐ 5–9
4 ☐ 10 or more

Name ______________________
Title ______________________
Company ______________________
Address ______________________
City ____________ *Country* ____________
Code ____________ *Telephone* ____________

CIRCLE FOR FREE INFORMATION

48IRSE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162
163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189
190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216
217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243
244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297
298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324
325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351
352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378
379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405
406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432
433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486
487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513
514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567
568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594
595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621
622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648
649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675
676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702
703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729
730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756
757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783
784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810
811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837
838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864
865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891
892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918
919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945
946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972
973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999

Discover Parallel Processing!

Monoputer™

The Most Cost Effective Transputer Development System

MicroWay's **Monoputer** is the best selling Transputer-based PC coprocessor in the world. It was the first board available to run the 20 MHz T414 or T800. As a result, it received many rave reviews in the UK (available on request) and became the standard Transputer software development tool. Parallel code can be executed on a single Monoputer or on an array of Monoputers wired together by their external link lines. The Monoputer includes 2 megabytes of 100 nsec DRAM, a 20 MHz T414 or T800 and the MicroWay stand alone Occam Compiler, which generates Transputer code that runs under MS-DOS. Optional tools include our licensed version of the TDS and a Pascal, Fortran, C, and Prolog.

Quadputer™

Mainframe Power For Your PC!

MicroWay's **Quadputer** is the most versatile multiple Transputer coprocessor on the market today. It can be purchased with 2, 3, or 4 Transputers, each of which has 1 or 4 megabytes of local memory. Two or more Quadputers can be easily cabled together to build larger parallel processor systems. A single Quadputer using four T800s provides 40 MIPS of CPU and 6 megaflops of NDP throughput at one fiftieth the cost of a comparably performing mainframe.

For more information please call (617) 746-7341. After July, 1988, call (508) 746-7341.

MicroWay

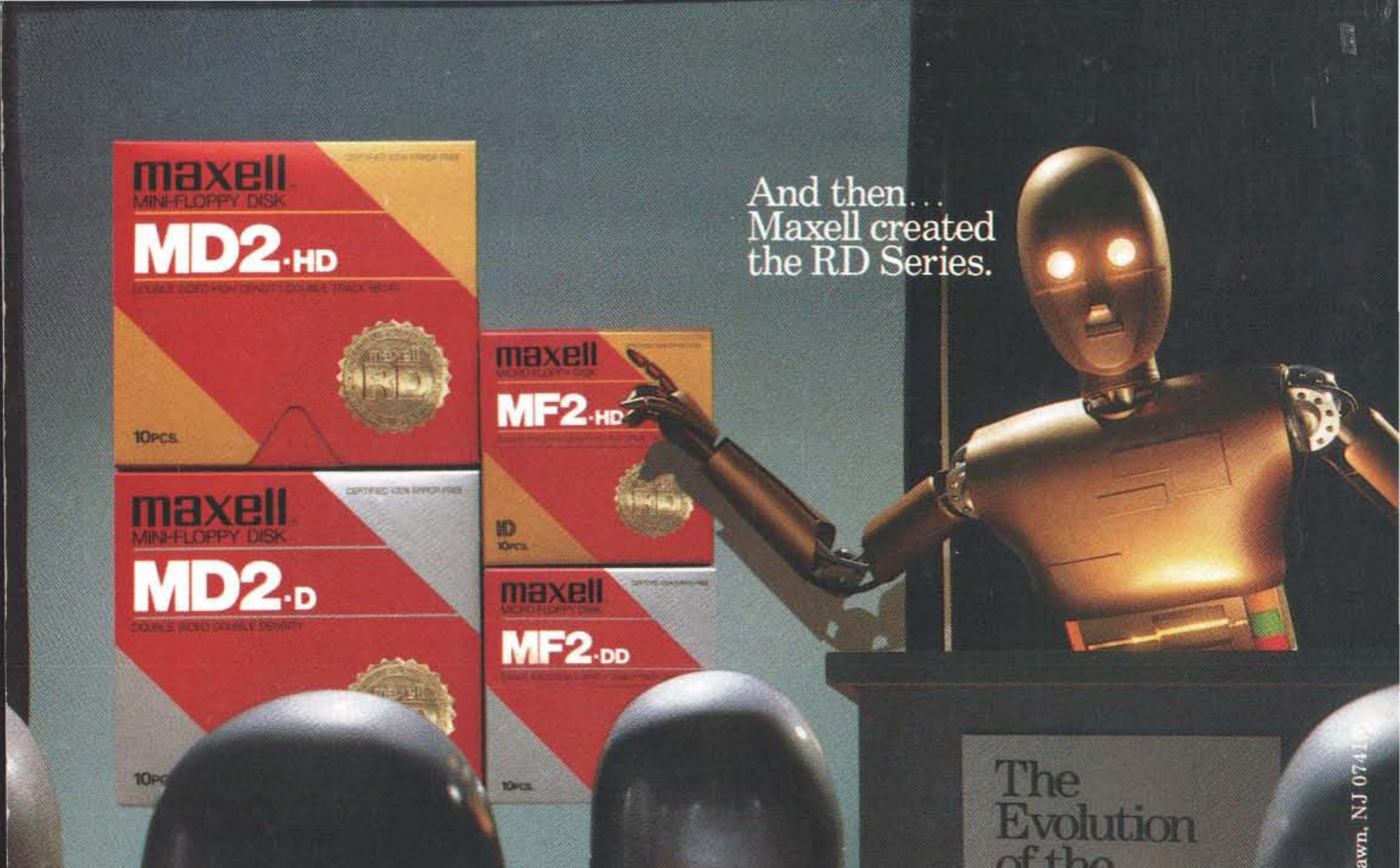
See us at Fall COMDEX Booth #W500 West Hall.

The World Leader in PC Numerics

P.O. Box 79, Kingston, Mass. 02364 USA (617) 746-7341
32 High St., Kingston-Upon-Thames, UK 01-541-5466
USA FAX 617-934-2414; Germany 069-75-1428; St. Leonards, NSW, Australia 02-439-8400

TRADEMARKS: Quadputer, Biputer and Monoputer of MicroWay, Inc. INMOS, Transputer, TDS, OCCAM of INMOS Corp. MicroWay™ is a registered trademark of MicroWay, Inc.

Circle 145 on Reader Service Card



Never before has this level of Reliability
and Durability been available in floppy disks.
Introducing the new RD Series from Maxell.
Twice the durability of the disks you're now using.
Twice the resistance to dust and dirt.
And the RD Series is ten times more reliable
than conventional floppy disks.
The Gold Standard has always meant maximum
safety for your data. Now it means even more.

maxell®
THE GOLD STANDARD